8. Affected Environment and Environmental Consequences (Biological Environment)

8.1 Terrestrial Biota/Habitat

8.1.1 Terrestrial Biota/Habitat Environment

The terrestrial environment of Rehoboth Beach contains a high-energy sand beach. The area is highly developed landward of the dune line and consists of a boardwalk, hotels, restaurants, and condominiums. Within this community, single family homes have been built. As reported in the Final Environmental Assessment for Alternative Sand Sources and Stormwater Outfall Extensions for the Rehoboth Beach and Dewey Beach Storm Damage Reduction Program (USACE 2002), “the predominant vegetation growing on the dune areas consisted of American beachgrass, sea rocket, and beach clotbur. Because most of the dune area is primarily dune, fauna inhabiting the dune is scarce but may include several species of passerine birds, and typical mammalian species such as the eastern cottontail. The plants found on the dunes are in a mostly barren area above the high tide line with little biological activity. Several species of gulls may be present within the upper and lower beach. The lower beach including the intertidal zone is frequently inhabited by shorebirds including sanderling, semipalmated sandpipe, and western sandpiper.” During the spring season, shorebirds such as the ruddy turnstones and black-bellied plovers utilize the beach habitat for feeding and resting before continuing their migration north (E. Stetzar 2011a) (Tsipoura and Burger 1999). All summer, willets can be found in the beach habitat, and terns use the beach for resting between foraging activities (E. Stetzar 2011a).

8.1.2 Short Term / Temporary Impacts

8.1.2.1 No action

The no action alternative would involve no new construction; thus, there would be no short term impact on terrestrial biota habitats.

8.1.2.2 Land Application

DNREC records show no state-rare or federally listed plants, animals or natural communities along the proposed alignment (E. Stetzar 2011). However, the proposed alignment does cross over creeks associated with rare, threatened and endangered species that could be indirectly impacted from sediment. Stringent erosion and sediment controls would be required to minimize impacts.

Several species of nesting migratory birds, such as barn swallows (*Hirundo rustica*) or Eastern phoebe (*Sayornis phoebe*), may be using the underside of the bridge crossing Love Creek as a nesting ground. If a visual survey confirms a substantial number of nests, construction should be restricted to between August 1 and April 15, or deterrents such as mesh netting should be used (E. Stetzar 2011).

8.1.2.3 Ocean outfall

Construction of the ocean outfall force main and outfall has the potential to impact terrestrial biota/habitats along the force main and at the directional drilling staging area. Impacts to the lower and upper beach areas, dunes, the intertidal zone, and their associated terrestrial species are not anticipated since the pipeline will be directional drilled in those areas. As discussed in Section 4.4 and (Appendix G), construction of the force main from RBWWTP to the ocean outfall will have minimal environmental impact because the alignment will follow existing utilities and roadways. DNREC records show no state-rare or federally listed plants, animals or natural communities along the proposed alignment or at the proposed beach crossing (E. Stetzar 2011).

8.1.3 Long Term / Chronic Impacts

8.1.3.1 No action

There will be no long term impacts to terrestrial biota/habitat under the no action alternative since effluent will continue to be discharged to surface waters.

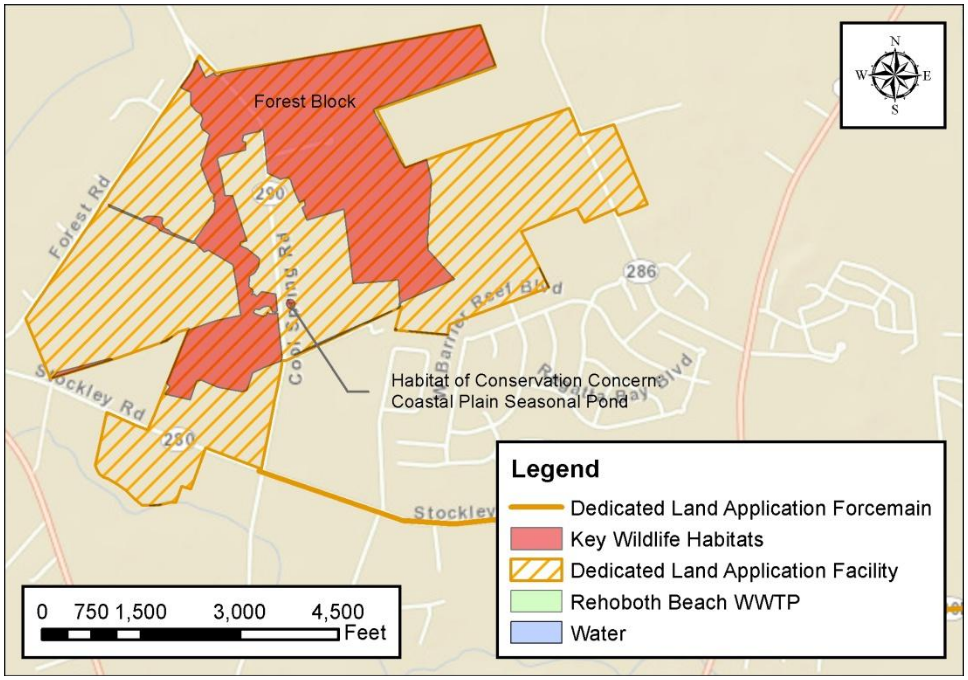
8.1.3.2 Land Application

A detailed survey of the proposed land application site for state-rare or federally listed plants, animals or natural communities has not been performed. However, a portion of the proposed land application site is mapped as a Key Wildlife Habitat by the Delaware Wildlife Action Plan indicating that it is an area of the state where conservation efforts should be focused (Allen, Barkus and Bennett 2006). This designation is not-regulatory. The Key Wildlife Habitats are shown in Figure 8-1.

If the land application alternative is selected, DNREC Natural Heritage and Endangered Species Program will survey the proposed site, map vegetation communities, and evaluate habitat for the potential to support species of conservation concern (E. Stetzar 2011).

The coastal plain pond called out in Figure 8-1 is a unique wetland type that can provide breeding habitat for a variety of animals, including amphibians and invertebrates, and support a unique and rare assemblage of plants. Upland buffers will need to be left intact along the forest and wetland areas to protect these areas from excess nutrients, minimize invasion by non-native species, and to provide habitat critical to the life cycle of wetland dependent species (E. Stetzar 2012).

Figure 8-1 Key Wildlife Habitats within the Land Application Facility (Allen, Barkus and Bennett 2006)



The impact to terrestrial biota/habitat from land application is difficult to ascertain. In one report, there were no measurable changes in the populations of small animals and birds in areas subjected to spray irrigation (Sorber 1974). However, other studies have observed changes to bird populations as vegetation changes in response to land application of effluent (Rollfinke, Yahner and Wakeley 1990) (Rohnke and Yahner 2008). These changes were mainly observed when effluent was land applied in forests, which will not be the case at Rehoboth's land application facility, though the facility will be adjacent to forests. A wildlife study by Pennsylvania State University (Wood, Simpson and Dressler 1973), reported the preference of wild deer to use irrigated areas for feeding and resting compared to control (non-irrigated) area. While observation on wild rabbit population shows that the larger and healthier rabbits are those trapped in irrigated area. These rabbits are a third heavier as a result of higher level of nutrition and improved cover condition. It is predicted that the use of treated effluent is unlikely to adversely affect terrestrial wildlife (such as moles and robins) that typically inhabit golf courses and parks, likely candidate sites to be irrigated with treated effluent (King County DNR 1998). In one study, salamanders confined to irrigated soils for 35 days showed no difference in growth, body water concentration, body sodium, potassium, calcium or magnesium levels. However, laboratory trials performed as part of the same study showed higher body sodium concentrations in salamanders on wastewater effluent soaked substrates than those on deionized water substrates (Laposata and Dunson 2000). Another study showed that there was significantly fewer egg masses, hatching success, and larval survival of wood frogs (*Rana sylvatica* LeConte), Jefferson salamanders (*Ambystoma jeffersonianum* Green), and spotted salamanders (*A. maculatum* Gravenhorst).in wastewater-irrigated ponds compared to natural ponds (Laposata and Dunson 2000a).

Plants are more likely to be directly affected by the use of treated effluent than animals, though any impact to plants will also impact any animals that depend on the plants for habitat and/or food. In a study by Pennsylvania State University (Sopper 1974), significant changes have been observed in species composition, vegetation density, height growth, and the percentage of areal cover (area covered by the plant), and nutrient utilization. After 12 years of irrigation with treated effluent, several predominant species prior to treated effluent irrigation were drastically reduced in number and disappeared completely. The density of goldenrod (*solidago spp*) reduced by more than 90%, or in the case of White Aster (*Aster pilous*) is no longer present on the site. The new predominant species is clearweed (*Pilea pumila L.*) which covers more than 80% of irrigated area.

8.1.3.3 Ocean Outfall

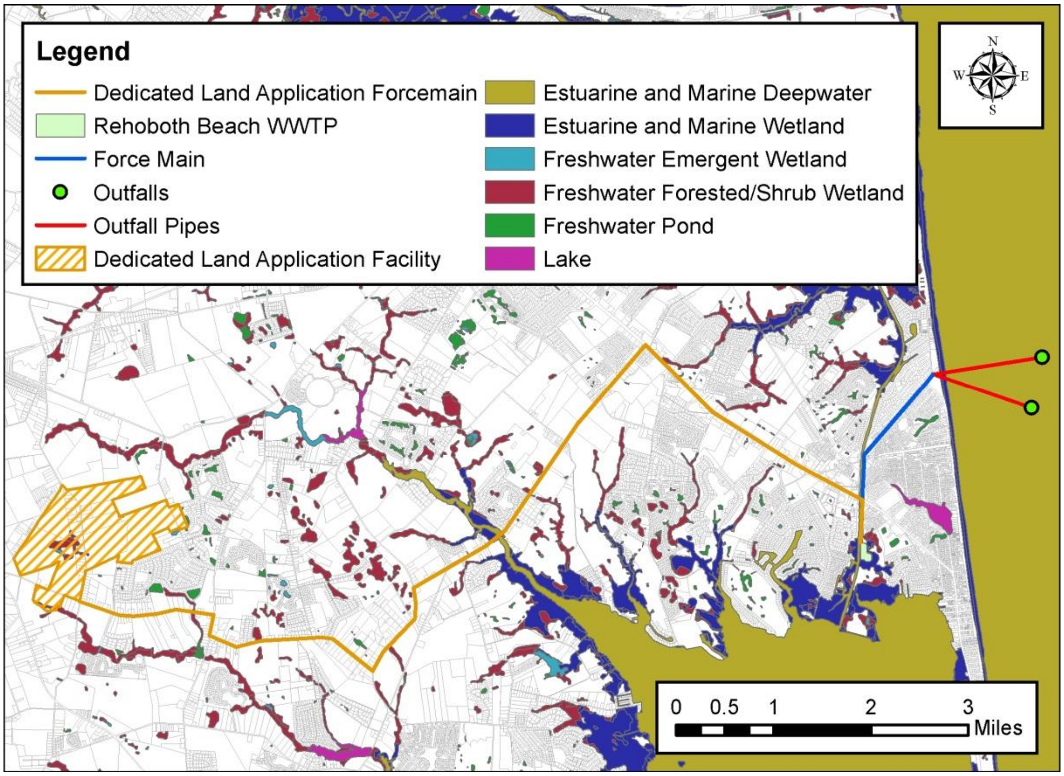
There will be no long term impacts to terrestrial biota/habitat under the ocean outfall alternative since effluent will continue to be discharged to surface waters. All land disturbed during construction will be returned to existing grade, and all components will be below grade. Repopulation by native biota/vegetation is expected to occur in the small areas disturbed by construction.

8.2 Wetlands Biota/Habitat

8.2.1 Wetlands Biota/Habitat Environment

Wetlands in Delaware are mostly broken up into two types: estuarine wetlands and palustrine wetlands. Estuarine wetlands include tidal marshes, mudflats, and sandy beaches and are found in intertidal salt and brackish environments. Palustrine wetlands include tidal fresh marshes, nontidal marshes and wet meadows, and occur upstream of the area of salt-water penetration. Delaware also has marine, riverine, and lacustrine wetlands though these are less common (Tiner 2001). Local wetlands are shown in Figure 8-2.

Figure 8-2 Local Wetlands (U.S. Fish and Wildlife Service 2011)



8.2.2 Short Term / Temporary Impacts

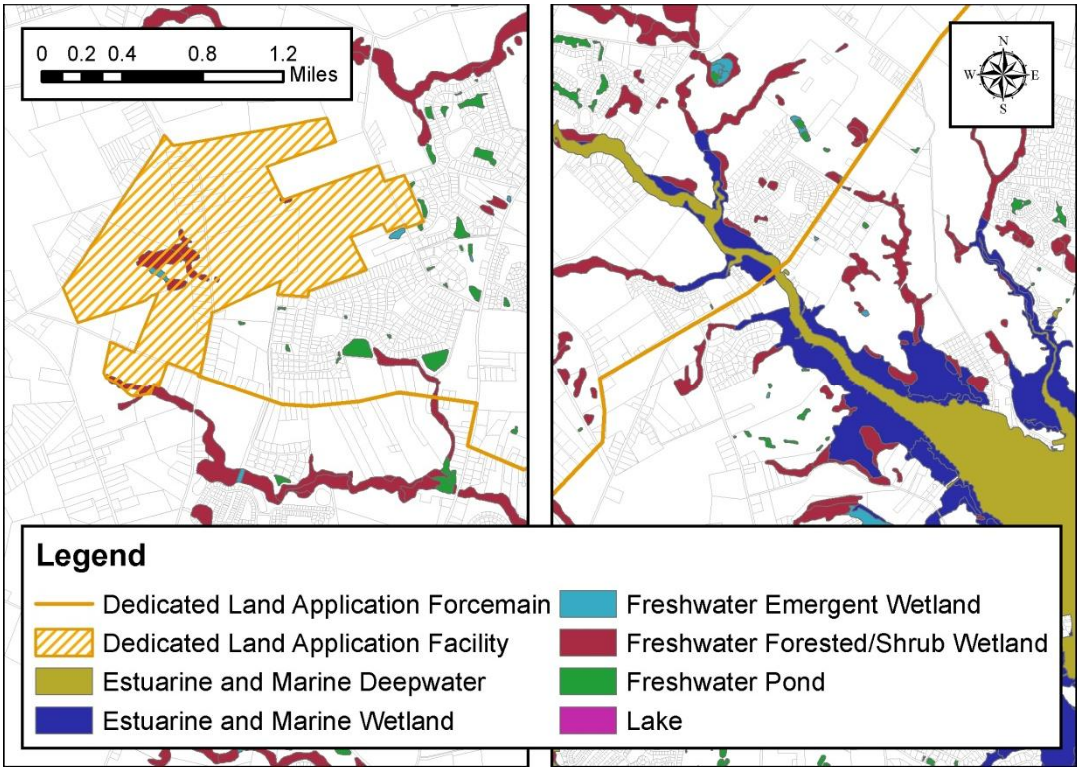
8.2.2.1 No Action

The no action alternative would involve no new construction; thus, there would be no short term impact on wetland biota habitats.

8.2.2.2 Land Application

The proposed forcemain alignment for the land application alternative will predominantly follow existing roads, so impact from construction will be minimal. The proposed location for the dedicated land application facility currently contains freshwater forested/shrub wetlands and freshwater emergent wetlands. If the land application facility is constructed here, potential significant impacts to wetland biota/habitats may exist. Local wetlands in the vicinity of the proposed dedicated land application facility and forcemain are shown in Figure 8-3.

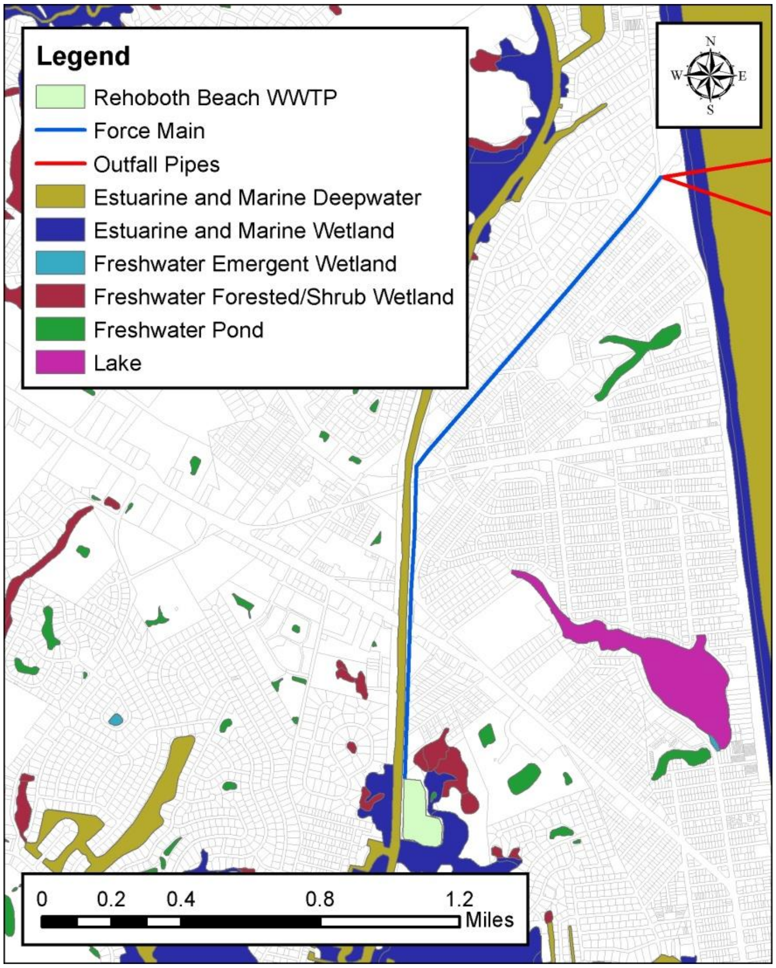
Figure 8-3 Wetlands Impacted by Land Application Alternative (U.S. Fish and Wildlife Service 2011)



8.2.2.3 Ocean Outfall

The proposed forcemain alignment will predominantly follow existing roads, and no construction will be required in wetlands (see Figure 8-4). A Federal 404 Wetland Jurisdictional Determination Report was performed along the proposed forcemain alignment for the RBWWTP Effluent Forcemain Study (Appendix G). No Federal 404 wetlands were found along the proposed alignment, thus the ocean outfall alternative is not expected to have a short term impact on wetland biota/habitats.

Figure 8-4 Wetlands Impacted by Ocean Outfall Alternative (U.S. Fish and Wildlife Service 2011)



8.2.3 Long Term / Chronic Impacts

8.2.3.1 No Action

Under the no action alternative, treated effluent from RBWWTP will continue to contribute to the poor water quality of Rehoboth Bay. The many wetlands surrounding the Bay (as shown in Figure 8-2) could potentially be affected by the degradation of the Bay.

8.2.3.2 Land Application

Effluent disposed by land application will percolate into the shallow aquifer and thus, will have no impact on wetland biota/habitat.

8.2.3.3 Ocean Outfall

Under the ocean outfall alternative, effluent will be disposed at least 4,400 feet offshore, where any nutrients or contaminants will be rapidly dispersed to concentrations below background levels. Thus, the effluent will have no impact on wetland biota/habitats.

8.3 Aquatic Biota/Habitat

8.3.1 Benthic Biota

8.3.1.1 Benthic Environment

The benthic biota includes macroinvertebrates dwelling in the substrate (infauna) or on the substrate (epifiruna). Benthic invertebrates provide a food source for most fish and are thus, an important part of the food chain. Benthic assemblages in Delaware coastal waters exhibit seasonal and spatial variability. In general, coarse sandy sediments are inhabited by filter feeders and areas of soft silt or mud are more utilized by deposit feeders (USACE 1996).

8.3.1.1.1 Benthic Environment in Rehoboth Bay

From 1968 to 1970, amphipods were collected from numerous stations throughout Rehoboth Bay (Watling and Maurer 1972). The species observed are presented in Table 8-1. A separate study investigated the decapods within Rehoboth Bay (Leathem and Maurer 1980), and the species observed are presented in Table 8-2.

Table 8-1 Amphipod species in Rehoboth Bay (Watling and Maurer 1972)

Taxon	Number of Stations Occupied	
	Summer	Winter
Total Stations	52	21
Infaunal tube dwellers		
Ampelisca abdita	43	7
A. vadorum	2	5
A. verrilli	9	2
Listriella barnardi	2	--
Infaunal non-tube dwellers		
Parahaustorius attenuatus	1	--
P. holmesi	1	--

Taxon	Number of Stations Occupied	
	Summer	Winter
P. longimerus	--	--
Pseudohaustorius caroliniensis	--	--
Lysianopsis alba	24	7
Monoculodes edwardsi	7	1
Paraphoxus spinosus	23	3
P. epistomus	11	6
Epifaunal tube dwellers		
Corophium acherusicum	16	--
C. insidiosum	24	1
C. tuberculatum	15	--
Cymadusa compta	7	--
Microdeutopus gryllotalpa	28	2
Microprotopus raneyi	T	--
Epifaunal non-tube dwellers		
Ampithoe valida	1	T
Batea catharinensis	T	T
Gammarus mucronatus	7	--
Elasmopus laevus	11	2
Melita appendiculata	1	T
Orchestia grillus	1	--
Caprella penantis	6	1
Paracaprella tenuis	--	--

Table 8-2 Decapod species in Rehoboth Bay (Leathem and Maurer 1980)

Taxon
Cancer irroratus
Eurypanopeus depressus
Homarus amerieanus
Libinia dubia
Libinia emarginata
Neopanope sayi

8.3.1.1.2 Benthic Environment in the Ocean

Benthic studies of eight areas off the coast of Delaware were conducted in 2000 for a beach replenishment project (Scott 2001). Three of these areas are in the vicinity of the proposed ocean outfall as shown in Figure 8-5 (Scott 2001). The other five areas were located farther south closer to Indian River Bay. The potential locations proposed for the ocean outfall are located either in or very close to Area 6.

In the USACE benthic report (Scott 2001), three samples were taken in each sample area in the vicinity of the two possible proposed outfall locations (Areas 6, 7, and 8). Based on the limited benthic sampling conducted in each area, the benthic community within the higher relief HCS area (Area 7) was very similar to one lower relief referenced area to the east (Area 8) but was different from the reference Area 6 to the West. Area 6, which includes the proposed outfall locations, contained many more bivalves such as *Ensis directus* and *Tellina agilis*, than the other two areas, and is also dominated by mossuscs (about 44%) and oligochaete worms (about 25%) and polychaete worms (about 21%) (Scott 2001). The HCS area and Area 8 were dominated by mobile arthropods. Surf clam resources within all the areas were very sparse. The ten most abundant infaunal taxa in Area 6 and the mean abundance observed are presented in

Table 8-3.

Previous benthic data collected near the mouth of Delaware Bay from 1980 through 1985 also showed a biomass dominated by mollusks (Steimle 1990). The location of this data collection is also shown in Figure 8-5.

Figure 8-5 USACE Report Study Areas (Scott 2001)

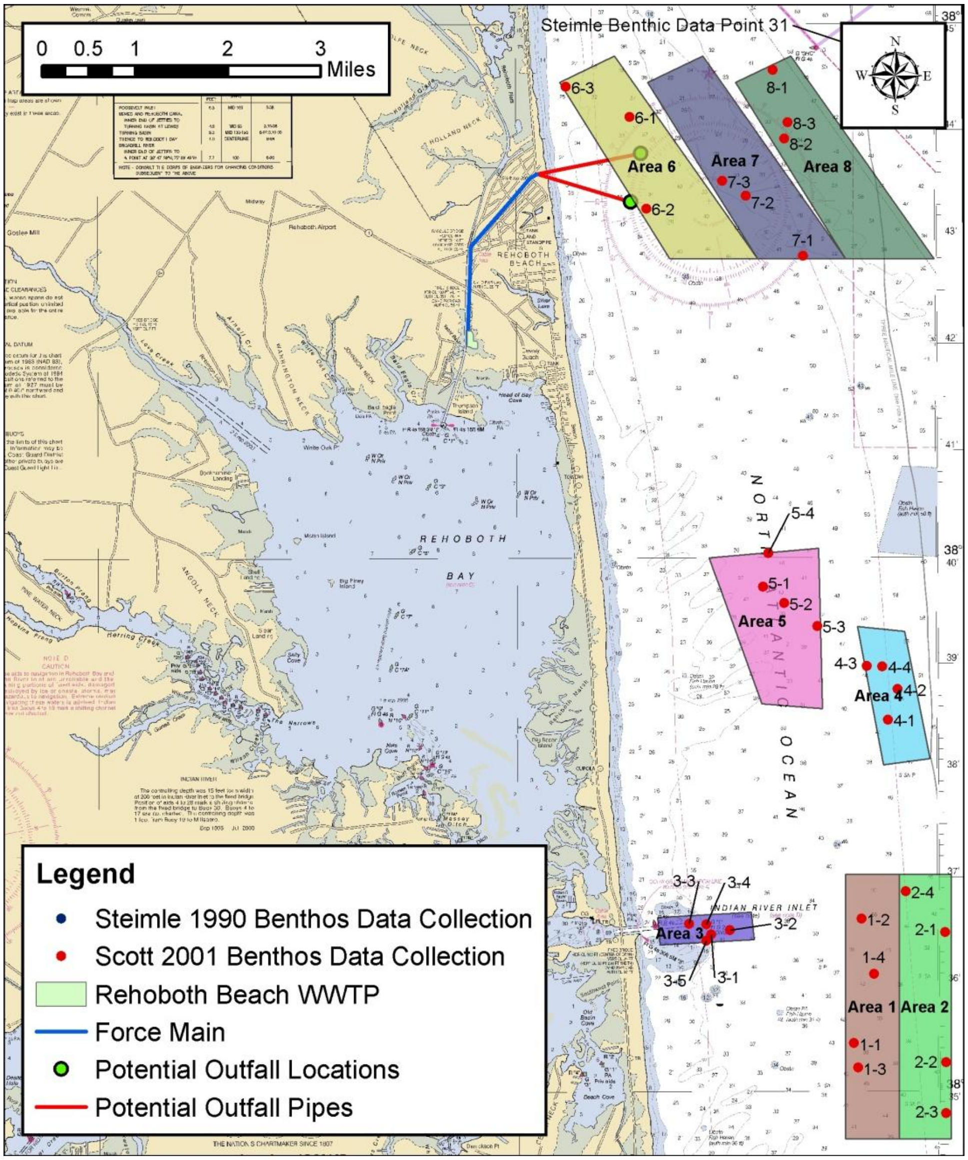


Table 8-3 Mean abundance of the ten most abundant infaunal taxa in Area 6 (Scott 2001)

Taxon		Mean abundance (#/m^2)
Nemertinea		
	Nemertinea	197.0
Annelida : Polychaeta		
	Amastigos caperatus	159.1
	Brania wellfleetensis	181.8
	Polygordius spp.	325.8
	Travisia sp. A (Morris)	121.2
Annelida : Oligochaeta	Oligochaeta	2,000.0
Mollusca : Bivalvia		
	Ensis directus	2,113.6
	Spisula solidissima	219.7
	Tellina agilis	1,075.8
Chordata : Ascidiacea		
	Molgulidae	159.1

In the intertidal zone, which is very dynamic due to wave action and shifting sands, species identified include the mole crab (Emerita talpoida), the coquina clam (Donax variabillis), a haustorid amphipod (Haustorius canadensis) and a spionid worm (Scolelepis squamata (USACE 2002). The nearshore zone includes both intertidal and offshore species, and biological diversity typically increases as the water deepens (USACE 2002).

8.3.1.2 Short Term / Temporary Impacts

8.3.1.2.1 No Action

There will be no short term impacts from the no action alternative, as no construction will occur.

8.3.1.2.2 Land Application

There will be no short term impacts to benthic organisms from the land application alternative, as no construction will occur in any aquatic environments.

8.3.1.2.3 Ocean Outfall

Under the Ocean Outfall alternative, there are no anticipated cumulate impacts involving intertidal and nearshore benthic organisms as the proposed pipe will be directionally drilled well below the ocean bottom in that area. Benthos in the vicinity of the outfall diffuser or the trenched portion of the outfall pipe would be impacted by dredging and backfill operations as the diffuser is installed (see Section 4.5.4 for a description of the portions of the outfall pipe that will be trenched). The impacts of such an operation would be minor and short–term. All excavations will be backfilled with the excavated material, which minimizes changes to sediment composition and thus reduces the impact on the benthic community (Scott 2001). Benthic communities in the disturbed area are initially decimated but resettling and recolonization occur rapidly. Complete recovery is typically achieved within three months to a few years (Scott 2001).

If the ocean outfall alternative is selected, benthic biota sampling will be done before and after construction to determine what effect, if any, construction had on the benthic community.

8.3.1.3 Long Term / Chronic Impacts

8.3.1.3.1 No Action

The no action alternative will have no impact on organisms in the benthic zone of the ocean, as disinfected effluent would continue to be discharged into Rehoboth Bay. Under the no action alternative, effluent from RBWWTP will continue to contribute to the eutrophication of Rehoboth Bay. As discussed in Section 3.1.1.2 of this report, over enrichment leads to phytoplankton blooms, which are damaging to the local ecosystem, including small benthic invertebrates which relay on plant biomass for a food source (DNREC 1995).

8.3.1.3.2 Land Application

Effluent is not disposed into any aquatic environment in the land application alternative, so the alternative will have no long term or chronic impacts to benthic organisms. Land applied effluent will receive further treatment and dilution as it percolates to the aquifer.

8.3.1.3.3 Ocean Outfall

Long term impacts to the benthic community from effluent discharge are expected to be minor. A five year monitoring program of the effects of waste water discharge from a major ocean outfall in Southern California on benthic communities was performed by Diener et. al. (1995). The study revealed that natural features, such as water depth, “accounted for 82% of the variability of the benthic community, while discharge-related effects represented less than 8% of the variability”. The community composition in the near field area showed the greatest discharge related effects, but biota diversity remained high, and the area was not characterized by a degraded community.

8.3.2 Phytoplankton

8.3.2.1 Phytoplankton environment

Phytoplankton are microscopic organisms that utilize photosynthesis to convert sunlight into food. As a primary producer, phytoplankton serves as the base of the aquatic food chain and most other organisms within the marine environment are dependent on them.

Approximately 126 species of phytoplankton were identified in the coastal waters of Delaware (USACE 1996). The most prevalent species and their season of dominance are presented in Table 8-4.

Table 8-4 Most Prevalent Observed Phytoplankton (USACE 1996)

Species	Season(s) of Dominance
Nitzschia seriata	Winter
Skeletonema costatum	Late winter, early spring
Guinarkia flaccida	Spring
Pyramimonas sp.	Spring, early summer
Cryptomonas acuta	Summer
Katodinium rotundatum	Mid-summer
Chrysochromulina sp.	Summer

8.3.2.2 Short Term / Temporary Impacts

8.3.2.2.1 No Action

There will be no short term impacts from the no action alternative, as no construction will occur.

8.3.2.2.2 Land Application

There will be no short term impacts to phytoplankton from the land application alternative, as no construction will occur in any aquatic environments.

8.3.2.2.3 Ocean Outfall

Construction of the trenched portion of the outfall pipe will increase local turbidity, which may impact the ability of phytoplankton to receive sunlight for photosynthesis. However, the potential mortality of phytoplankton caused by construction activity would not be as great as the natural mortality rates under normal circumstances (Louis Berger Group, Inc. 1999).

8.3.2.3 Long Term / Chronic Impacts

8.3.2.3.1 No Action

Under the no action alternative, treated effluent from RBWWTP will continue to be discharged into Rehoboth Bay, which could impede the recovery of the Bay from nutrient over enrichment. As discussed in Section 3.1.1.2 of this report, over enrichment leads to phytoplankton blooms, which are damaging to the local ecosystem.

8.3.2.3.2 Land Application

Effluent is not disposed into any aquatic environment in the land application alternative, so the alternative will have no long term or chronic impacts to phytoplankton.

8.3.2.3.3 Ocean Outfall

Nutrients within the effluent would be rapidly dispersed in the ocean, preventing the conditions that lead to phytoplankton blooms. Phytoplankton levels in Rehoboth Bay would decrease as the nutrient load decreases, and this will be beneficial to the ecosystem of the Bay.

8.3.3 Submerged Aquatic Vegetation

8.3.3.1 Submerged Aquatic Vegetation Environment

Submerged aquatic vegetation (SAV) is vegetation that is attached to the sediment bottom and does not rise through the surface of the water. Both macroalgae (seaweeds) and aquatic vascular rooted plants (sea grasses) are considered SAV. Sea grasses are similar to land vegetation and are firmly rooted to the sediment. Conversely, seaweeds are held in place by holdfasts that are much weaker than roots, and thus part of the population is detached and drifting (DNREC 2001).

Like phytoplankton, SAV is a crucial part of the aquatic ecosystem since it converts sunlight into food for other organisms. In addition, sea grass prevents erosion, dampens wave and current energy, improves water clarity, and provides habitats for numerous aquatic species (DNREC 2001).

The seaweed community in Rehoboth Bay is dominated by red algae of the genera *Agardhiella* and *Gracilaria,* which is branching in structure. *Ulva*, or sea lettuce, is also common in the Rehoboth Bay and is a green algae that forms flat sheets (DNREC 2001).

Previous studies of the Atlantic Ocean in the vicinity of the proposed outfall do not mention any SAV off of the coast of Delaware (Maurer, et al. 1976) (USACE 2002). Thus, there is not expected to be any SAV on the ocean floor in the project area.

8.3.3.2 Short Term / Temporary Impacts

8.3.3.2.1 No Action

There will be no short term impacts from the no action alternative, as no construction will occur.

8.3.3.2.2 Land Application

There will be no short term impacts to SAV from the land application alternative, as no construction will occur in any aquatic environments.

8.3.3.2.3 Ocean Outfall

The ocean outfall will be directionally drilled under the dunes and beach and thus will not affect the vegetation in these areas. There is no record of SAV near the areas that will be trenched for construction of the outfall pipe and outfall diffuser. Due to the small size of the disturbed area, if there was SAV in the area, rapid recovery would be expected.

8.3.3.3 Long Term / Chronic Impacts

8.3.3.3.1 No Action

Under the no action alternative, effluent from RBWWTP will continue to contribute to the eutrophication of Rehoboth Bay. The excessive growth of phytoplankton and seaweed resulting from eutrophication block sunlight from reaching SAV on the bay bottom. The extinction of SAV has been observed in the Inland Bays (DNREC 2001), and if nutrient loading is not reduced, the SAV will continue to suffer. As a food source for numerous species of waterfowl, fish, and invertebrates, SAV is a critical part of the bay ecosystem. In addition, the structure of SAV provides a habitat to many fish and invertebrates, serves as a site of attachment for other small plants, and prevents shoreline erosion (DNREC 2001). Impacts to SAV in Rehoboth Bay will thus affect many aspects of the bay ecosystem.

8.3.3.3.2 Land Application

Effluent is not disposed into any aquatic environment in the land application alternative, so the alternative will have no long term or chronic impacts to SAV.

8.3.3.3.3 Ocean Outfall

Nutrients within the effluent would be rapidly diluted and dispersed in the ocean, preventing the conditions that lead to algae blooms and SAV death.

8.3.4 Fish

8.3.4.1 Local Fisheries Studies

In the USACE report (Wirth 2001), actual fisheries stocks for the beach replenishment project were sampled every two months from March through November 2000 within the areas shown in Figure 8-6. Three sampling gears were used with different species and size selectivity: experimental trawl, commercial trawl, and gillnets. The proposed ocean outfall is located in Area 6. The top ten most abundant species collected during the winter, spring, summer, and fall cruises within Area 6 are presented in Table 8-5.

Figure 8-6 USACE Fishery Study Areas (Wirth 2001)

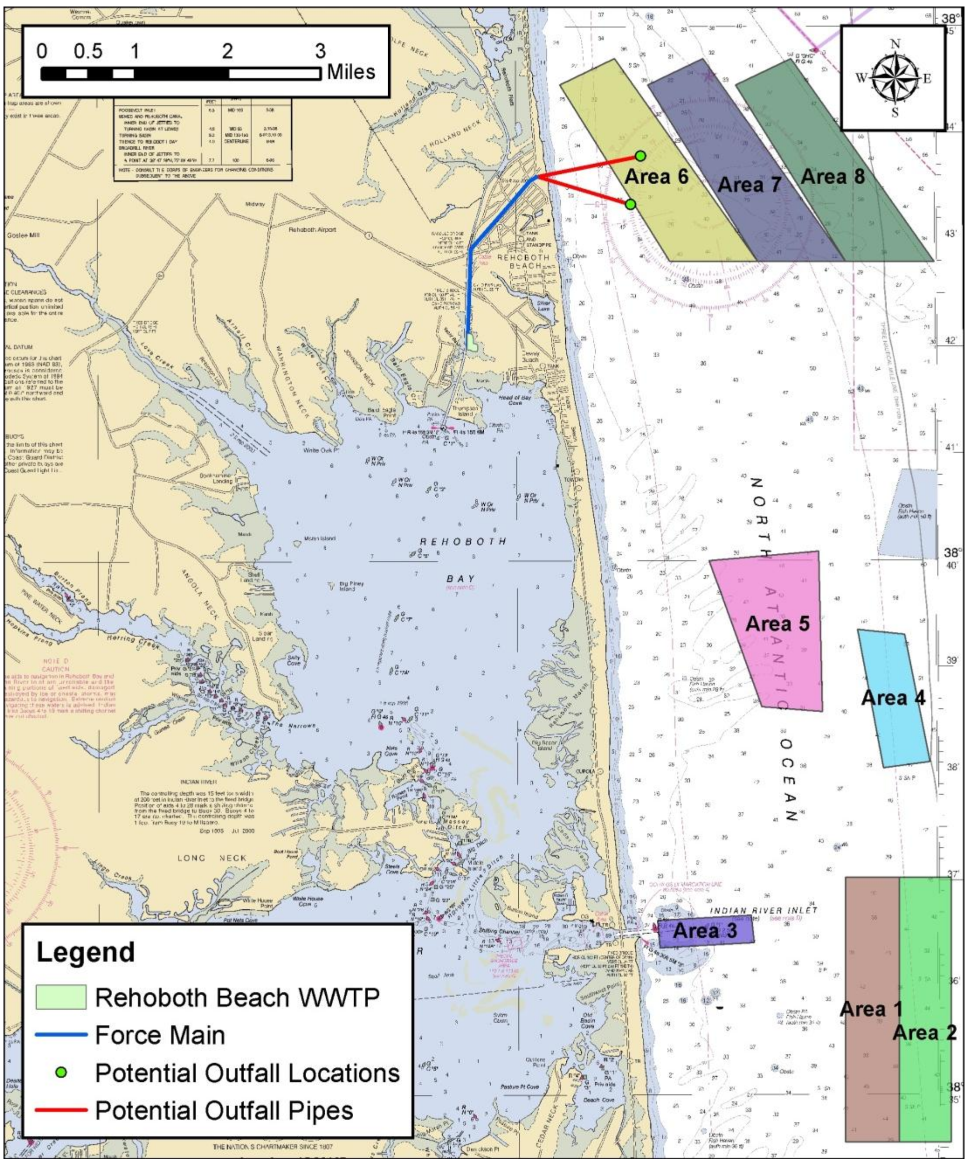


Table 8-5 Top Ten Most Prevalent Species Observed Each Season in Area 6 (Wirth 2001)

Common Name	Scientific Name	Total Individuals Captured				
		Winter	Spring	Summer	Fall	Total
Little skate	*Raja erinacea*	486.9	20	0	86.2	593.1
Bay anchovy	*Anchoa mitchilli*	000	0	10.5	420	430.5
Windowpane	*Scophthalmus aquosus*	251.5	5	7.1	52.2	315.8
Horseshoe crab	*Limulus polyphemus*	107.4	3.5	101	13.9	225.8
Starfishes	*Asteroidea*	0	0	39	178.2	217.2
Clearnose skate	*Raja eglanteria*	0	80.2	93.1	4.4	177.7
Knobbed whelk	*Busycon carica*	3	36.1	57	64.8	160.9
Lady crab	*Ovalipes ocellatus*	3	0	67.8	23.6	94.4
Blue crab	*Callinectes sapidus*	0	2.4	34	3	39.4
Summer flounder	*Paralichthys dentatus*	5	1	15	16.2	37.2
Butterfish	*Peprilus triacanthus*	0	0	4.1	10.4	14.5
Atlantic menhaden	*Brevoortia tyrannus*	0	0.2	2.2	12	14.4
Righthanded hermit crabs	*Paguridae*	0	0	10.5	3	13.5
Smooth dogfish	*Mustelus canis*	0	10.5	2	0	12.5
Atlantic croaker	*Micropogonias undulatus*	0	0	9	3	12
Winter skate	*Raja ocellata*	9	0	0	0	9
Portly spider crab	*Libinia emarginata*	0	4.4	4	0	8.4
Northern searobin	*Prionotus carolinus*	0	3	3	0	6
Channeled whelk	*Busycotypus canaliculatus*	0	4	0	0	4
Striped bass	*Morone saxatilis*	3.1	0	0	0	3.1
Sand shrimp	*Crangon septemspinosa*	3	0	0	0	3
Atlantic sturgeon	*Acipenser oxyrhynchus*	1	0	0	0	1

Note: List above only contains the top ten species observed each season and the top ten species observed overall. Some species are more prevalent overall than species shown in the table but were not included because they were not in the top ten species observed during any season.

Based upon the results of this study, the fish and shellfish communities in the vicinity of the Hen and Chicken Shoals (HCS) within Area 7 did not appear to be any different from the communities observed at Area 6, the proposed location of the outfall, even with the depth differences. Both areas are relatively low in abundance and diversity of benthic species and are both considered flat bottom areas. Species in Area 6 were grouped with other species in the area in this study. Although the species were low in abundance in the sampling area, the windowpane and the summer flounder, in the winter and fall seasons respectively, were both identified in this area as species under federal fishery management plans, which protect “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.”

Surveys of shellfish in the HCS area (Area 7) found the presence of the Atlantic surf clam but in relatively low densities compared to other areas surveyed off the coast. The bacteriological standard to protect harvestable shellfish is based on total coliform (MPN <70/100 mL) and the existing treatment plant is capable of disinfecting the effluent to a much lower level. It is anticipated that DNREC will establish a zone around the outfall where shellfishing is prohibited. However, it should be noted that removing the existing discharge from the canal could ultimately result in other areas, currently closed to shellfishing, being reopened as water quality improves.

Finfish found along the Delaware Atlantic coast are primarily seasonal migrants that in the winter tend to be sparse because they leave the area for the warmer waters further south. In the summer, they are more abundant and are attracted to local estuaries for spawning and nursing. An investigation identified 75 species of finfish throughout the sampling period; 55 of which were found in every season (Wirth 2001). In the winter there were 20 different species, in the spring there were 29 species and in the summer there were 36 different species collected. Overall, the most abundant species were the clearnose skate, bay anchovy, summer flounder and black sea bass.

8.3.4.2 Essential Fish Habitat Species

The Magnuson-Stevens Fishery Conservation and Management Act of 1996, as amended by the Sustainable Fisheries Act, established specific areas designated as Essential Fish Habitat (EFH) for the protection of specific species of federally managed fish. EFHs have been designated for a number of species and life stages of fish, shellfish, and mollusks within the 10 minute by 10 minute (0.17° by 0.17°) area around Rehoboth Beach shown in Figure 8-7. The EFHs within that area are presented in Table 8-6. EFHs have also been designated within the Delaware Inland Bays (including Rehoboth Bay) as listed in Table 8-7. The life stages found within the ocean and bay for each species are presented in Table 8-8 and the preferred habitats and migratory patterns of each are detailed.

Fish that occur in federal waters are managed by a specific Fishery Management Council based on the geographic distribution of the fish population. The fish species within the area delineated in Figure 8-7 are managed by the New England, Mid-Atlantic, and South Atlantic Fishery Management Councils. In addition, many highly migratory species, which are regulated by the National Marine Fishery Service, are listed as occurring within the Figure 8-7 area. Each of the fish species identified in Table 8-6 and Table 8-7 will be discussed in greater detail in the following sections. The area disturbed by the ocean outfall construction is only a small portion of the 104 square mile area for which EFH information was reported.

Figure 8-7 Essential Fish Habitat Area of Interest (NOAA 2011)

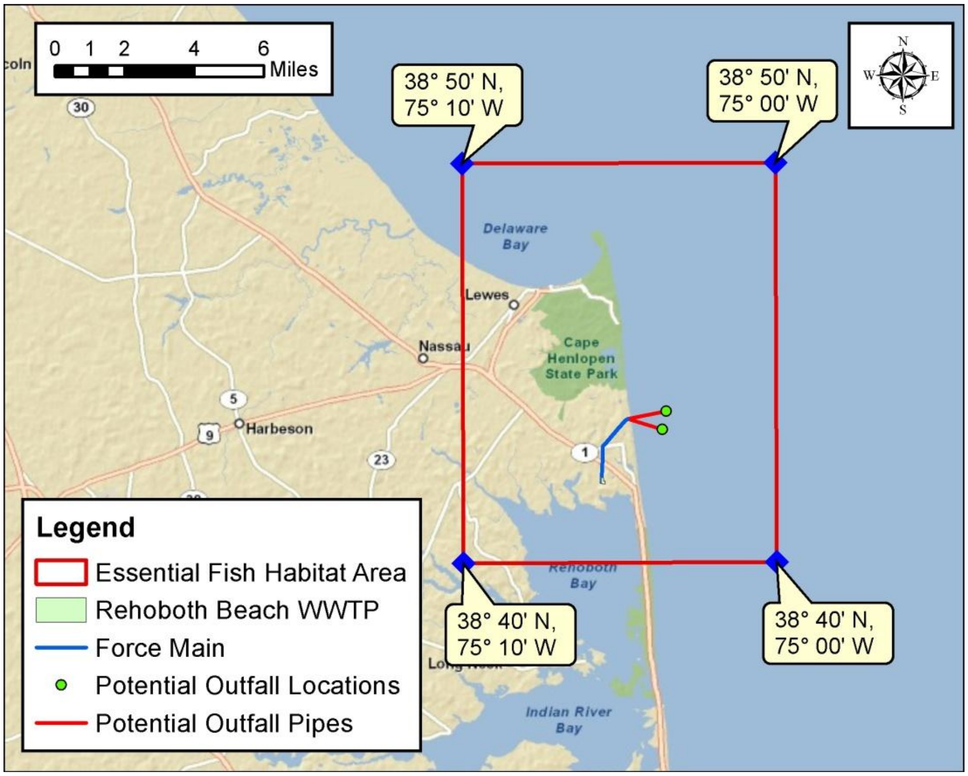


Table 8-6 Essential Fish Habitat Species in the Area (NOAA 2011)

Common Name	Scientific Name	Eggs	Larvae	Juveniles	Adults
Atlantic cod	*Gadus morhua*				X
red hake	*Urophycis chuss*	X	X	X	X
winter flounder	*Pseudopleuronectes americanus*	X	X	X	X
windowpane flounder	*Scophthalmus aquosus*	X	X	X	X
Atlantic sea herring	*Clupea harengus*			X	X
monkfish	*Lophius americanus*	X	X		
bluefish	*Pomatomus saltatrix*			X	X
Atlantic butterfish	*Peprilus triacanthus*		X	X	X
summer flounder	*Paralichthys dentatus*			X	X

Common Name	Scientific Name	Eggs	Larvae	Juveniles	Adults
scup	*Stenotomus chrysops*	n/a[1]	n/a[1]	X	X
black sea bass	*Centropristis striata*	n/a[1]	X	X	X
surf clam	*Spisula solidissima*	n/a[2]	n/a[2]	X	
spiny dogfish	*Squalus acanthias*	n/a[3]	n/a[3]		X
king mackerel	*Scomberomorus cavalla*	X	X	X	X
Spanish mackerel	*Scomberomorus maculatus*	X	X	X	X
cobia	*Rachycentron canadum*	X	X	X	X
sand tiger shark	*Carcharias taurus*		X		X
Atlantic angel shark	*Squatina dumerili*		X	X	X
Atl. sharpnose shark	*Rhizopriondon terraenovae*				X
dusky shark	*Carcharhinus obscurus*		X		
sandbar shark	*Carcharhinus plumbeus*		HAPC[4]	HAPC[4]	HAPC[4]
scalloped hammerhead shark	*Sphyrna lewini*			X	

Notes:

[1] There is insufficient data for the life stages listed for Scup and black sea bass, and no EFH designation has been made as of yet.

[2] surf clam are referred to as pre-recruits and recruits (this corresponds with juveniles and adults in the tables).

[3] Spiny dogfish have no eggs or larvae since juveniles are born live.

[4] HAPC = Habitat Area of Particular Concern.

Table 8-7 Essential Fish Habitat Species in the Delaware Inland Bays (NOAA 2011)

Common Name	Scientific Name	Eggs	Larvae / Neonate	Juveniles	Adults	Spawning Adults
winter flounder	*Pseudopleuronectes americanus*	M,S	M,S	M,S	M,S	M,S
windowpane flounder	*Scophthalmus aquosus*	M,S	M,S	M,S	M,S	M,S
American plaice	*Hippoglossoides platessoides*			M,S	S	
Atlantic sea herring	*Clupea harengus*			M,S	S	
bluefish	*Pomatomus saltatrix*			M,S	M,S	
Atlantic butterfish	*Peprilus triacanthus*			S	S	

Common Name	**Scientific Name**	**Eggs**	**Larvae / Neonate**	**Juveniles**	**Adults**	**Spawning Adults**
summer flounder	*Paralichthys dentatus*		M,S	M,S	M,S	
scup	*Stenotomus chrysops*			S	S	
black sea bass	*Centropristis striata*			M,S		
king mackerel	*Scomberomorus cavalla*	X	X	X	X	
Spanish mackerel	*Scomberomorus maculatus*	X	X	X	X	
cobia	*Rachycentron canadum*	X	X	X	X	

Notes:

S = The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > or = 25.0%).

M = The EFH designation for this species includes the mixing water/ brackish salinity zone of this bay or estuary (0.5% < salinity < 25.0%).

These EFH designations of estuaries and embayments are based on the NOAA Estuarine Living Marine Resources (ELMR) program.

Table 8-8 Habitats of Essential Fish Habitat Species in the Area (NOAA 1998)

Management Agency	Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description
New England Management Council	Atlantic cod	Adults	<10	(29 - 34)	10-150		Bottom habitats with a substrate of rocks, pebbles, or gravel
		Spawning Adults	<10	(10 - 35)	10-150	spawn during fall, winter, and early spring	Bottom habitats with a substrate of smooth sand, rocks, pebbles, or gravel
	Red hake	Eggs	<10	< 25		May to November, peaks in June and July	Surface waters of inner continental shelf
		Larvae	<19	>0.5	<200	May to December, peaks in Sept. and October	Surface waters
		Juveniles	<16	31 - 33	<100		Bottom habitats with substrate of shell fragments, including areas with an abundance of live scallops
		Adults	<12	33 - 34	10-130		Bottom habitats in depressions with a substrate of sand and mud
		Spawning Adults	<10	>25	<100	May to November, peaks in June and July	Bottom habitats in depressions with a substrate of sand and mud
	Winter flounder	Eggs	<10	10 - 30	<5	February to June, peak in April on GB	Bottom habitats with a substrate of sand, muddy sand, mud, and gravel

Management Agency	Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description
		Larvae	<15	4 - 30	<6	March to July, peaks in April and May on GB	Pelagic and bottom waters
		Juveniles (age 1+)	<25	10 - 30	1 - 50		Bottom habitats with a substrate of mud or fine grained sand
		Adults	<25	15 - 33	1 - 100		Bottom habitats including estuaries with substrate of mud, sand, gravel
		Spawning Adults	<15	5.5 - 36	<6*	February to June	Bottom habitats including estuaries with substrate of mud, sand, gravel
	Window-pane flounder	Eggs	<20		<70	February to November, peaks May and October in middle Atlantic July - August on GB	Surface waters
		Larvae	<20		<70	February to November, peaks May and October in middle Atlantic July - August on GB	Pelagic waters
		Juveniles	<25	5.5 - 36	1 - 100		Bottom habitats with substrate of mud or fine grained sand
		Adults	<26.8	5.5 - 36	1 - 75		Bottom habitats with substrate of mud or fine grained sand
		Spawning Adults	<21	5.5 - 36	1 - 75	February - December, peak in May in middle Atlantic	Bottom habitats with substrate of mud or fine grained sand

Management Agency	Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description
	Atlantic herring	Juveniles	<10	26 - 32	15-135		Pelagic waters and bottom habitats
		Adults	<10	>28	20-130		Pelagic waters and bottom habitats
		Spawning Adults	<15	32 - 33	20 - 80	July through November	Bottom habitats with a substrate of gravel, sand, cobble and shell fragments, also on aquatic macrophytes
	Monk-fish (Goose-fish)	Eggs	<18		15- 1000	March to September	Surface waters
		Larvae	15		25-1000	March to September	Pelagic waters
Mid-Atlantic Management Council	Bluefish	Juveniles	(19-24)	(23 - 36) freshwater zone in Albemarie Sound		North Atlantic estuaries from June to October Mid-Atlantic estuaries from May to October South Atlantic estuaries from March to December	Pelagic waters
		Adults	(14-16)	>25 ppt		North Atlantic estuaries from June to October Mid-Atlantic estuaries from April to October South Atlantic estuaries from May to January	Pelagic waters
	Butter-	Larvae	9 - 19	(6.4 - 37)	10-1829	(summer and fall)	Pelagic waters

Management Agency	Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description
	fish	Juveniles	3 - 28	(3 - 37)	10-365 (most <120)	(winter - shelf spring to fall - estuaries)	Pelagic waters (larger individuals found over sandy and muddy substrates)
		Adults	3 - 28	(4 - 26)	10-365 (most <120)	(winter - shelf summer to fall - estuaries)	Pelagic waters (schools form over sandy, sandy-silt and muddy substrates)
	Summer flounder	Juveniles	>11	10 -30 Fresh in Narrag. Bay, Albem/ Pamlico Sound, & St. Johns R.	(0.5-5) in estuary		Demersal waters, muddy substrate but prefer mostly sand; found in the lower estuaries in flats, channels, salt marsh creeks, and eelgrass beds
		Adults		Fresh in Albemarie Sound, Pamlico Sound, & St. Johns R.	(0 - 25)	Inhabit shallow coastal and estuarine waters during warmer months and move offshore on outer Continental Shelf at depths of 492 ft (150 m) in colder months	Demersal waters and estuaries
	Scup	Eggs	13 - 23	>15	(<30)	May - August	Pelagic waters in estuaries
		Larvae	13 - 23	>15	(<20)	May - September	Pelagic waters in estuaries
		Juveniles	>7	>15	(0 - 38)	Spring and summer in estuaries and bays	Dermersal waters north of Cape Hatteras and Inshore on various sands, mud, mussel, and eelgrass bed type substrates

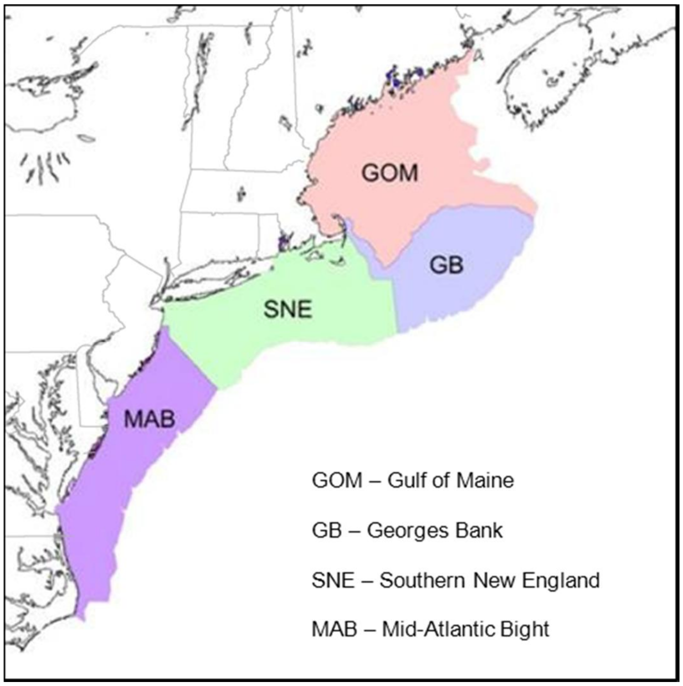
Management Agency	Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description
		Adults	>7	>15	(2 -185)	Wintering adults (November - April) are usually offshore, south of NY to NC	Dermersal waters north of Cape Hatteras and Inshore estuaries (various substrate types)
	Black sea bass	Eggs			0 - 200	May to October	Water column of coastal Mid-Atlantic Bight and Buzzards Bay
		Larvae	(11-26)	(30 - 35)	(<100)	(May - Nov, peak Jun - Jul)	Habitats for transforming (to juveniles) larvae are near coastal areas and into marine parts of estuaries between Virginia and NY. When larvae become demersal, found on structured inshore habitat such as sponge beds.
		Juveniles	>6	>18	(1 - 38)	Found in coastal areas (Apr - Dec , peak Jun - Nov) between VA and MA, but winter offshore from NJ and south; Estuaries in summer and spring	Rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas, offshore clam beds and shell patches may be used during wintering
		Adults	>6	(>20)	(20- 50)	Wintering adults (Nov. to April) offshore, south of NY to NC Inshore, estuaries from May to October	Structured habitats (natural & man-made) sand and shell substrates preferred

Management Agency	Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description
	Surf clams	Juveniles	(2-30)		0 -60 , low density beyond 38		Throughout substrate to a depth of three feet within federal waters. (Burrow in med. To coarse sand and gravel substrates. Also found in silty to fine sand, not in mud)
	Spiny Dogfish	Adults	3 - 28	(30 - 32)	10-450		Continental Shelf waters and estuaries
South Atlantic Management Council	King mackerel		>20	>30			Sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island ocean side waters from surf zone to shelf break but from the Gulf Stream shoreward;
	Spanish mackerel		>20	>30			Sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island ocean side waters from surf zone to shelf break but from the Gulf Stream shoreward;
	Cobia		>20	>25			Sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island ocean side waters from surf zone to shelf break but from the Gulf Stream shoreward; high salinity bays, estuaries, seagrass habitat.

This table was compiled by NMFS Northeast Regional Office, Habitat Conservation Division. All information presented is part of the Regional Fishery Management Council's EFH designations except for that contained within ( ) which is provided as important additional ecological information. Definitions: GOME - Gulf of Maine; GB - George's Bank; HAPC - Habitat Area of Particular Concern; YOY - Young-of-Year Please note: This Table does not contain EFH info on Highly Migratory Species (sharks, tunas, billfish).

The descriptions of EFH within the North Atlantic frequently refer to the four sub-regions of the northeast continental shelf ecosystem. These sub-regions include the Gulf of Maine, Georges Bank, Southern New England, and Mid-Atlantic Bight, and are shown in Figure 8-8.

Figure 8-8   Sub-regions of the Northeast continental Shelf Ecosystem (NEFSC 2007)



8.3.4.3   New England Essential Fish Habitat Species

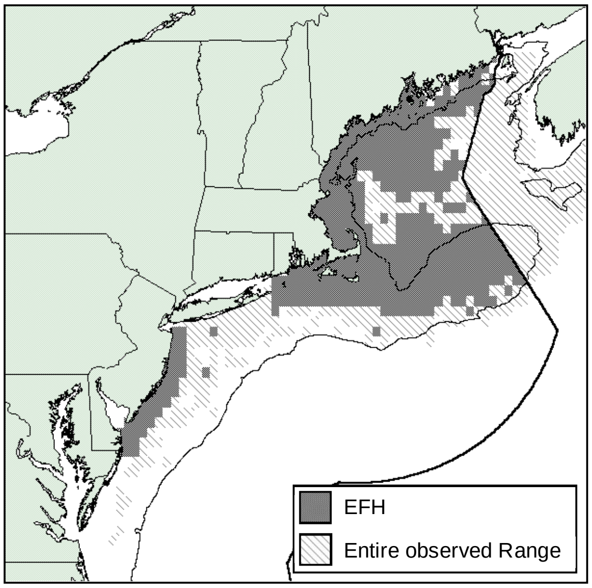
8.3.4.3.1   Atlantic Cod

The EFH for only the adult stage of Atlantic cod is present near the location of the proposed outfall (NOAA 2011). Adult Atlantic cod in the northwest Atlantic Ocean extend from Greenland to Cape Hatteras, North Carolina (see Figure 8-9, with the highest densities off the coasts of Newfoundland, Nova Scotia, Maine, and Massachusetts. The greatest concentrations off the northeast coast of the United States are on rough bottoms in waters 33 to 492 ft (10 to 150 m) deep between temperatures of 32 and 50 °F (0 and 10°C) (NOAA 1999).

Atlantic cod in the northern and southern extents of the fishery migrate annually. In the mid-Atlantic blight, near the location of the proposed outfall, cod only occur during winter and spring, and return to northern waters when the temperatures exceed 68°F (20°C). In addition, cod off the coast of New England “typically move into coastal waters during the fall and then retreat into deeper waters during spring” (NOAA 1999).

The Atlantic cod has a varied diet, but “the most frequently observed food items were invertibraes with fishes comprising only a minor component” (NOAA 1999).

Figure 8-9 Adult Atlantic Cod Essential Fish Habitat (NOAA 1998)



8.3.4.3.2 Red Hake

EFHs for the egg, larvae, juvenile, and adult stages of red hake are present near the location of the proposed outfall (NOAA 2011). Red hake in the northwest Atlantic Ocean occur from Nova Scotia to Cape Hatteras, NC, and are most abundant off of Cape Cod, MA and Long Island, NY (NOAA 1999a). During warmer months, red hake are common in depths less than 328 ft (100 m), whereas during colder months they are more common in depths greater than 328 ft (100 m).

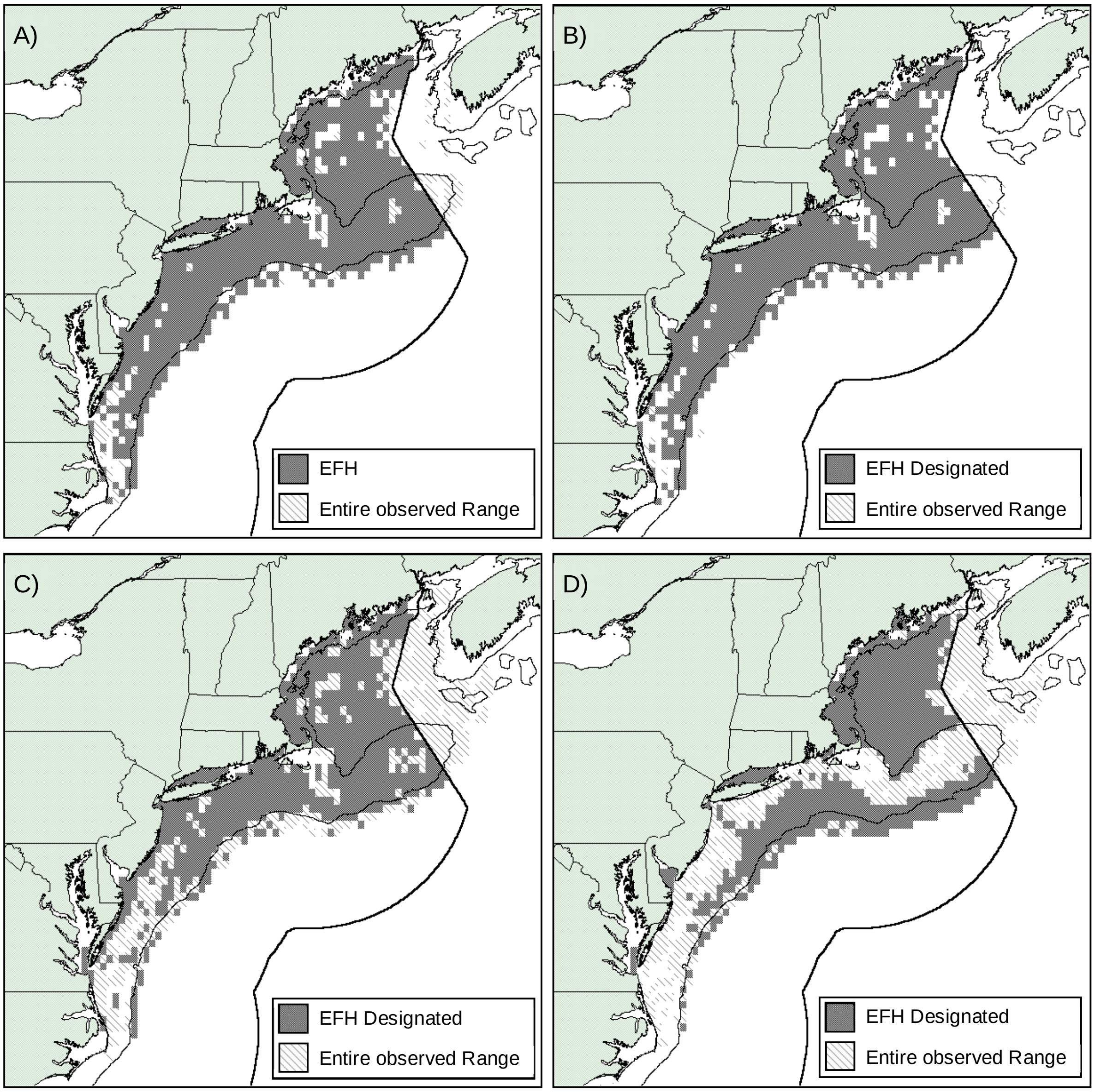
Red hake eggs and larvae are most common in the surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England and the middle Atlantic south to Cape Hatteras. In general, red hake eggs are found where sea surface temperatures are below 50°F (10°C) along the inter-continental shelf with a salinity of less than 25‰. Red hake larvae are found at depths are less than 656 ft (200 m) where sea surface temperatures are below 66°F (19°C) and salinity is greater than 0.5‰. Eggs are mostly observed between May and November with peaks in June and July. Larvae are most often observed from May to December with a peak in September and October (NOAA 1998). Distribution of red hake eggs and larvae are presented in Figure 8-10A and B.

Red hake juveniles prefer bottom habitats with a substrate of shell fragments in the Gulf of Maine, Georges Bank, the continental shelf off southern New England and the middle Atlantic south to Cape Hatteras. In general, red hake juveniles are found at depths less than 328 ft (100 m), where water temperatures are below 61°F (16°C), and salinity is between 31-33‰ (NOAA 1998). Distribution of red hake juveniles is presented in Figure 8-10C.

Red hake adults prefer bottom habitats with a substrate of sand and mud in the Gulf of Maine, Georges Bank, the continental shelf off southern New England and the middle Atlantic south to Cape Hatteras. In general, red hake adults are found at depths from 33 to 427 ft (10 to 130 m) where water temperatures are below 73°F (23°C), and salinity is between 33-34‰. Spawning adults prefer depths less than 328 ft (100 m) where water temperatures are below 50°F (10°C), and salinity less than 25‰. Spawning most often occurs between May and November, peaking in June and July (NOAA 1998). Distribution of red hake adults is presented in Figure 8-10D.

Red hake larvae prey primarily on copepods and other micro-crustaceans. Juvenile and adult red hake consume small benthic and pelagic crustaceans, including larval and small decapod shrimp and crabs, mysids, euphausiids, and amphipods. In addition, adult red hake also consume a variety of demersal and pelagic fish and squid (NOAA 1999a).

Figure 8-10 Red Hake Essential Fish Habitat for A) Eggs B) Larvae, C) Juveniles, and D) Adults (NOAA 1998)



8.3.4.3.3 Winter Flounder

EFHs for the egg, larvae, juvenile, and adult stages of winter flounder are present near the location of the proposed outfall and in the Delaware Inland Bays (NOAA 2011). Winter flounder in the northwest Atlantic Ocean are distributed from Labrador, Canada to North Carolina and Georgia with the area of highest abundance off New Brunswick and northern Nova Scotia (NOAA 1999b). Near the location of the proposed outfall, adult winter flounder migrate inshore in the fall and early winter and spawn in late winter and early spring (NOAA 1999b).

Winter flounder eggs are found most commonly in bottom habitats with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the middle Atlantic south to the Delaware Bay. In general, winter flounder eggs are found in water depths less than 16 ft (5 m) where water temperatures are less than 50°F (10°C) and salinity is between 10 and 30‰ (NOAA 1998). The distribution of red hake eggs is presented in Figure 8-11A.

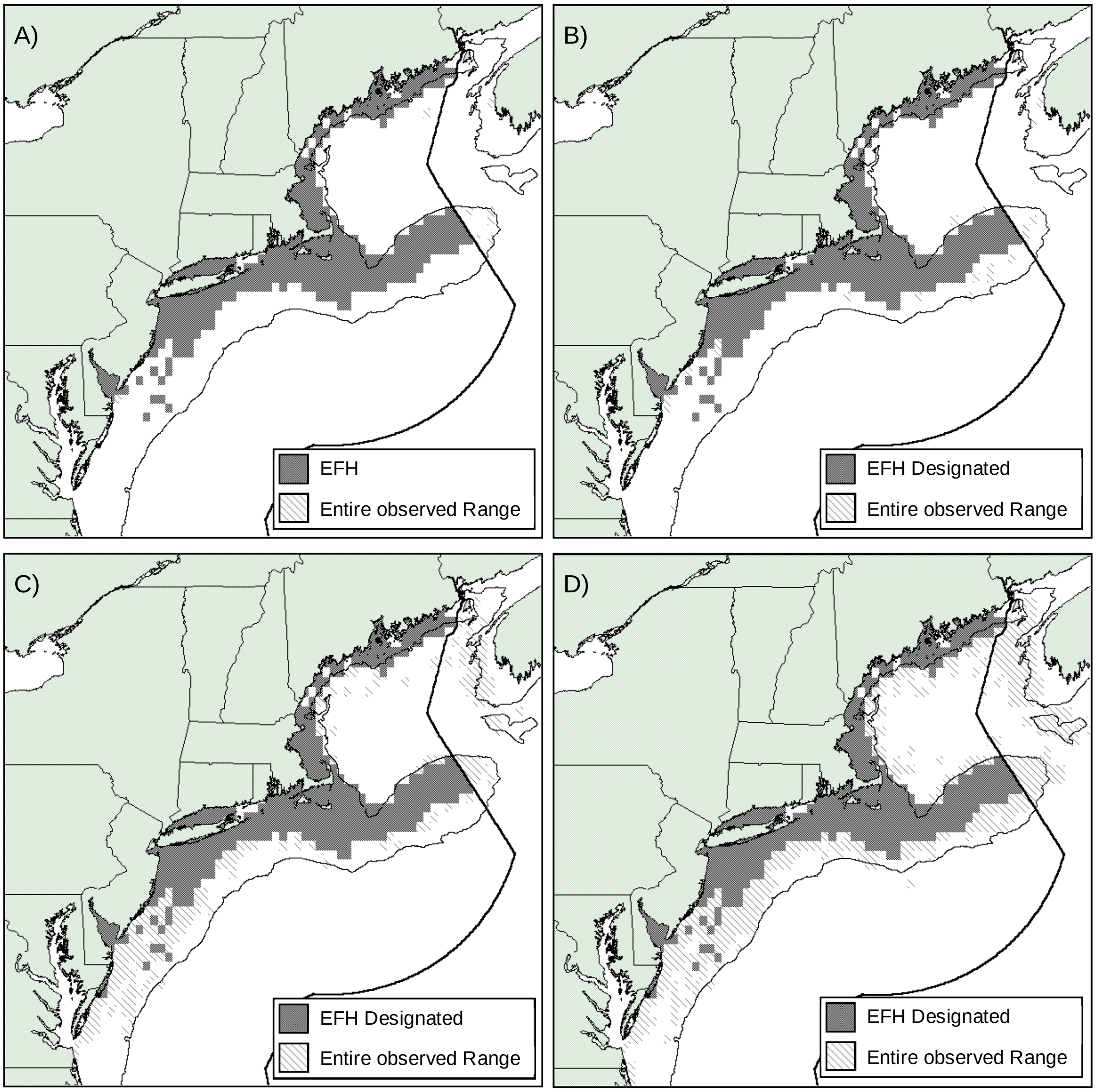
Winter flounder larvae are found most commonly in the pelagic and bottom waters of Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the middle Atlantic south to the Delaware Bay. In general, winter flounder larvae are found in water depths less than 20 ft (6 m) where sea surface temperatures are less than 59°F (15°C) and salinity is between 4 and 30‰ (NOAA 1998). The distribution of red hake larvae is presented in Figure 8-11B.

Winter flounder juveniles are mostly found in bottom habitats with a substrate of mud or fine grained sand on Georges Bank, the inshore areas of the Gulf of Maine, southern New England and the middle Atlantic south to the Delaware Bay. In general, winter flounder juveniles less than a year old are found in water depths of 0.3 to 33 ft (0.1 to 10 m) where water temperatures are below 82°F (28°C) and salinity is between 5 and 33‰ (NOAA 1998). Winter flounder juveniles older than a year are found in water depths of 3 to 164 ft (1 to 50 m) where water temperatures are below 77°F (25°C) and salinity is between 10 and 30‰ (NOAA 1998). The distribution of red hake juveniles is presented in Figure 8-11C.

Winter flounder adults are mostly found in bottom habitats including estuaries with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England and the middle Atlantic south to the Delaware Bay. In general, winter flounder adults are found in water depths of 3 to 164 ft (1 to 50 m) where water temperatures are below 77°F (25°C) and salinity is between 15 and 33‰ (NOAA 1998). Spawning adults are typically found in water depths less than 20 ft (6 m) where water temperatures are below 59°F (15°C). Winter flounders are observed spawning the most between February and June. The distribution of red hake adults is presented in Figure 8-11D.

Winter flounder consume a wide variety of prey and may modify their diet based on the availability of prey. Known prey includes polychaetes, crustaceans, annelids, amphipods, bivalves, capelin eggs, and fish (NOAA 1999b).

Figure 8-11 Winter Flounder Essential Fish Habitat for A) Eggs B) Larvae, C) Juveniles, and D) Adults (NOAA 1998)



8.3.4.3.4 Windowpane Flounder

EFHs for the egg, larvae, juvenile, and adult stages of windowpane flounder are present near the location of the proposed outfall and in the Delaware Inland Bays (NOAA 2011). Windowpane flounders occupy the northwest Atlantic Ocean from the Gulf of Saint Lawrence to Florida but are most common between Georges Bank and the Chesapeake Bay. Generally, windowpane inhabit shallow waters less than 361 ft (110 m) deep, with sand, sand/silt, or mud substrates, preferring depths of 3 to 184 ft (1 to 56 m) (NOAA 1999c).

Juveniles and adults may migrate to nearshore or estuarine habitats in the southern Middle Atlantic Bight in the autumn (NOAA 1999c).

Windowpane eggs are mostly found in surface waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. In general, windowpane eggs are found in water depths less than 230 ft (70 m) where surface temperatures are less than 68°F (20°C). Flounder eggs are observed from February to November with peaks in May and October (NOAA 1998). The distribution of windowpane eggs is presented in Figure 8-12A.

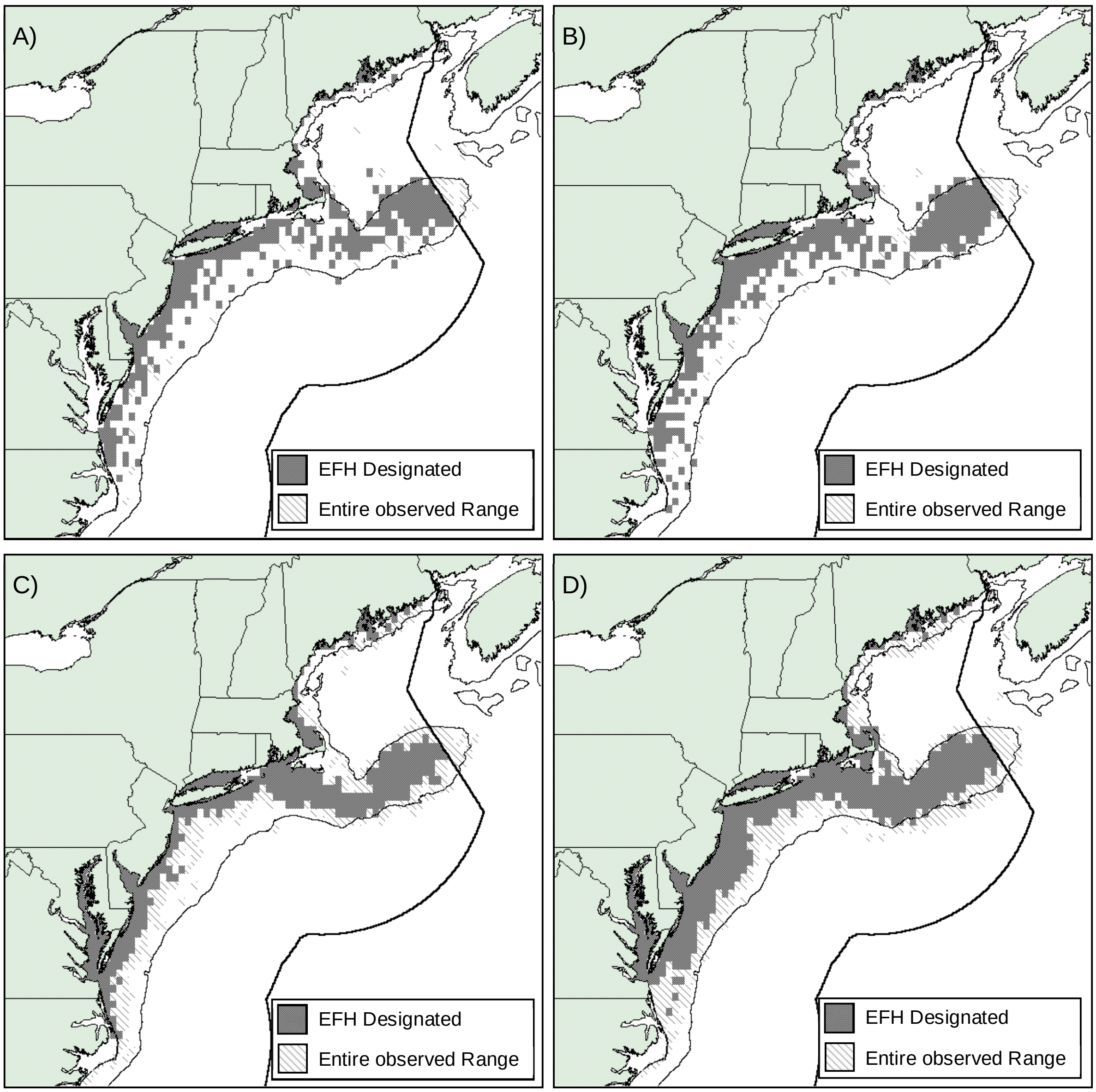
Windowpane larvae are mostly found in pelagic waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. In general, windowpane larvae are found in water depths less than 230 ft (70 m) where surface temperatures are less than 68°F (20°C). Flounder larvae are observed from February to November with peaks in May and October (NOAA 1998). The distribution of windowpane larvae is presented in Figure 8-12B.

Windowpane juveniles are mostly found in bottom habitats with a substrate of mud or fine-grained sand around the perimeter of the Gulf of Maine, on Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. In general, windowpane juveniles are found in water depths of 3 to 328 ft (1 to 100 m) where water temperatures are less than 77°F (25°C) and salinity is 5.5-36‰ (NOAA 1998). The distribution of windowpane juveniles is presented in Figure 8-12C.

Windowpane adults are mostly found in bottom habitats with a substrate of mud or fine-grained sand in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Virginia-North Carolina border. In general, windowpane adults are found in water depths of 3 to 246 ft (1 to 75 m) where salinity is 5.5-36‰ (NOAA 1998). Non-spawning adults prefer water temperatures below 80°F (26.8°C), and spawning adults prefer water temperatures below 70°F (21°C). Spawning occurs mostly between February and December with a peak in May in the middle Atlantic. The distribution of windowpane adults is presented in Figure 8-12D.

Windowpane flounders have been observed to feed on small crustaceans (e.g., mysids and decapod shrimp) and various fish larvae including hakes and tomcod, as well as their own species (NOAA 1999c).

Figure 8-12 Windowpane Flounder Essential Fish Habitat for A) Eggs B) Larvae, C) Juveniles, and D) Adults (NOAA 1998)



8.3.4.3.5 American plaice

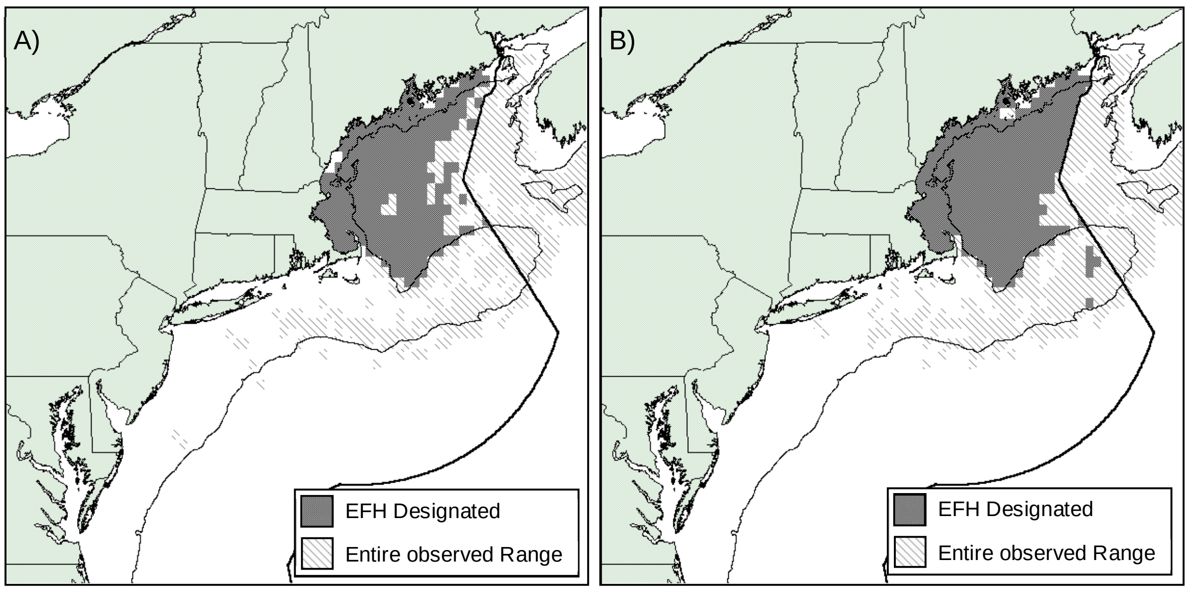
The Delaware Inland Bays are listed as EFHs for the juvenile and adult stages of American plaice (NOAA 2011).

American plaice juveniles are mostly found in bottom habitats with fine-grained sediments or a substrate of sand or gravel in the Gulf of Maine. In general, American plaice juveniles are found in water depths of 148 to

492 ft (45 to 150 m) where water temperatures are below 63°F (17°C) (NOAA 1998). The distribution of American plaice juveniles is presented in Figure 8-13A.

American plaice adults are mostly found in bottom habitats with fine-grained sediments or a substrate of sand or gravel in the Gulf of Maine and Georges Bank. In general, American plaice adults are found in water depths of 148 to 574 ft (45 to 175 m) where water temperatures are below 63°F (17°C) (NOAA 1998). The distribution of American plaice adults is presented in Figure 8-13B.

Figure 8-13 American Plaice Essential Fish Habitat for A) Juveniles, and B) Adults (NOAA 1998)



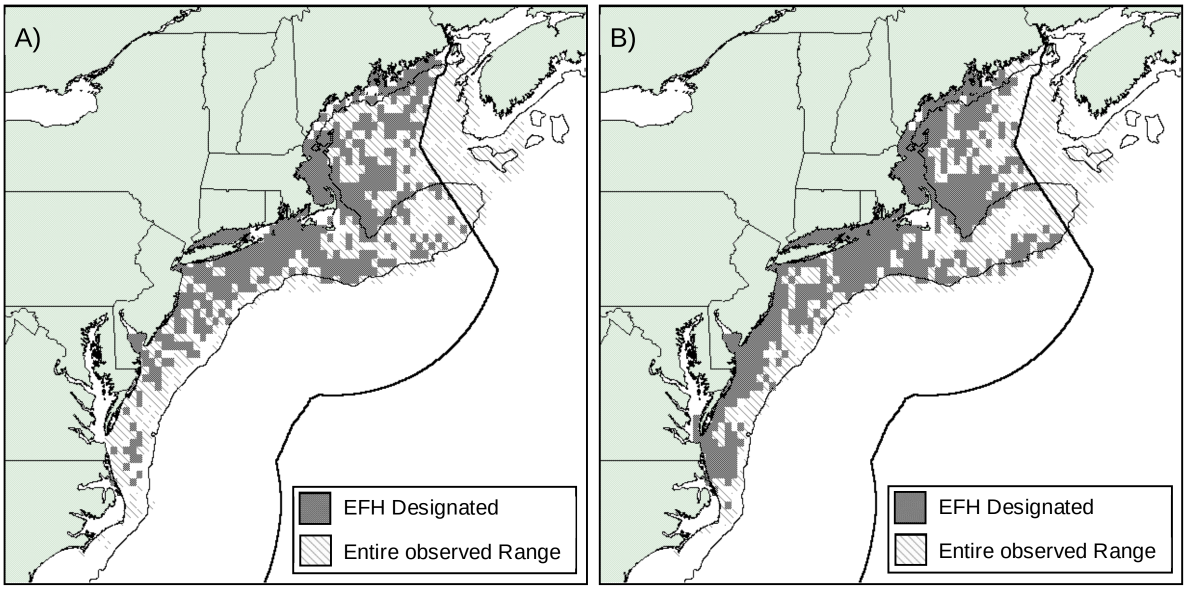
8.3.4.3.6 Atlantic Sea Herring

EFHs for the juvenile and adult stages of Atlantic sea herring are present near the location of the proposed outfall and in the Delaware Inland Bays (NOAA 2011). Atlantic Sea Herring occupy the northwest Atlantic Ocean from Labrador to Cape Hatteras. Juveniles and adults undergo complex inshore–offshore and north –south migrations (NOAA 1999e).

Atlantic sea herring juveniles and adults are mostly found in pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. In general, American plaice juveniles are found in water depths of 49 to 443 ft (15 to 135 m) where water temperatures are below 50°F (10°C) and salinity ranges from 26 to 32‰ (NOAA 1998). American plaice adults are found in water depths of 66 to 427 ft (20 to 130 m) where water temperatures are below 50°F (10°C) and salinity ranges from 28‰ (NOAA 1998). The distribution of Atlantic sea herring juveniles and adults is presented in Figure 8-14.

Herring diets in the Mid-Atlantic vary, but those in the northern areas have been found to eat euphausiids, copepods, amphipods, mysids, chaetognaths, and unidentified fish larvae (NOAA 1999e).

Figure 8-14 Atlantic sea herring Essential Fish Habitat for A) Juveniles, and B) Adults (NOAA 1998)



8.3.4.3.7 Monkfish (Goosefish)

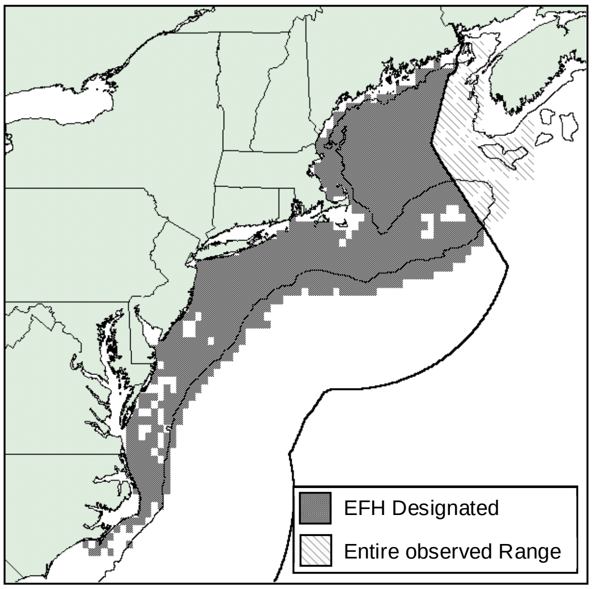
EFHs for the egg and larvae stages of monkfish (goosefish) are present near the location of the proposed outfall (NOAA 2011). Monkfish extend from the southern and eastern parts of the Grand Banks, (Newfoundland) and the northern side of the Gulf of St. Lawrence, to the east coast of Florida, but they are common only north of Cape Hatteras (NOAA 1999f).

Monkfish eggs are mostly found in surface waters of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras, North Carolina. In general, monkfish eggs are found in water depths of 49 to 3,281 ft (15 to 1,000 m) where sea surface temperatures are below 64°F (18°C). Monkfish eggs are most often observed from March to September (NOAA 1998). The distribution of Atlantic sea herring juveniles and adults is presented in Figure 8-15.

Monkfish larvae are mostly found in Pelagic waters of the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras, North Carolina. In general, monkfish eggs are found in water depths of 82 to 3,281 ft (25 to 1,000 m) where water temperatures are below 59°F (15°C). Monkfish larvae are most often observed from March to September (NOAA 1998). The distribution of Atlantic sea herring juveniles and adults is presented in Figure 8-15.

Larvae monkfish feed on zooplankton, including copepods, crustacean larvae, and chaetognaths (NOAA 1999f).

Figure 8-15 Monkfish Essential Fish Habitat for Eggs and Larvae (NOAA 1998)



8.3.4.4 Middle Atlantic Essential Fish Habitat Species

8.3.4.4.1 Bluefish

EFHs for the juvenile and adult stages of bluefish are present near the location of the proposed outfall and in the Inland Bays (NOAA 2011). Bluefish in the western North Atlantic range from Nova Scotia to Argentina, but are rare between southern Florida and northern South America (NOAA 1999g). Bluefish migrate seasonally, moving north in spring-summer to the New England Bight and southern New England, and moving south in autumn-winter to the South Atlantic Bight as far as Florida. In addition, the bluefish move into the Middle Atlantic Bight during spring and move farther offshore during fall (NOAA 2006).

North of Cape Hatteras, the EFH for bluefish juveniles is pelagic waters found over the Continental Shelf (from the coast out to the limits of the exclusive economic zone (EEZ)) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90% of the area where juvenile bluefish are collected in the Northeast Fisheries Science Center (NEFSC) trawl survey. EFH also includes the "slope sea" and Gulf Stream between latitudes 29° N and 40° N. Inshore, the EFH for juveniles is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Generally, juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones (Nelson et al. 1991, Jury et al. 1994, Stone et al. 1994). Distribution of juveniles by temperature, salinity, and depth over the continental shelf is undescribed (Fahay 1998) (NOAA 1998).

North of Cape Hatteras, the EFH for bluefish adults is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90% of the area where adult bluefish were collected in the NEFSC trawl survey. Inshore, the EFH for adults is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones (Nelson et al. 1991, Jury et al. 1994, Stone et al. 1994). Bluefish adults are highly migratory and distribution varies seasonally and according to the size of the individuals comprising the schools. Bluefish generally found in normal shelf salinities (> 25 ppt) (NOAA 1998).

Bluefish juveniles and adults eat whatever taxa are locally abundant, and have been observed to consume fish, crustaceans, and polychaetes. Larger adults are known to target larger species of prey such as squids, clupeids, and butterfish (NOAA 2006).

8.3.4.4.2 Atlantic Butterfish

EFHs for the larvae, juvenile, and adult stages of Atlantic butterfish are present near the location of the proposed outfall and EFH for the juvenile and adult stages are present in the Inland Bays (NOAA 2011). Butterfish in the western North Atlantic range from Newfoundland to Florida, but are most abundant between the Gulf of Maine and Cape Hatteras. In winters, butterfish are found near the edge of the continental shelf in the Middle Atlantic Bight, but in the spring they migrate inshore in the spring into southern New England. In the summer, butterfish occur over the entire mid-Atlantic shelf and in the late fall, they move southward and offshore (NOAA 1999h).

Offshore, the EFH for Atlantic butterfish larvae is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina areas that comprise the highest 75% of the catch where butterfish larvae were collected in the NEFSC trawl surveys. Inshore, the EFH for Atlantic butterfish larvae is the "mixing" and/or "seawater" portions of all the estuaries where butterfish larvae are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. In general, Atlantic butterfish larvae are found in water depths of 33 to 6,000 ft (10 to 1,829 m) and temperatures between 48°F (9°C) and 66°F (19°C) (NOAA 1998).

Offshore, the EFH for Atlantic butterfish juveniles and adults is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina in areas that comprise the highest 75% of the catch where butterfish of the respective life stage were collected in the NEFSC trawl surveys. Inshore, EFH for Atlantic butterfish juveniles and adults is the "mixing" and/or "seawater" portions of all the estuaries where juvenile butterfish are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. In general, juvenile and adult butterfish are found in water depths of 33 to 1,200 ft (10 to 366 m) and temperatures between 37°F (3°C) and 82°F (28°C) (NOAA 1998).

Atlantic butterfish consume mainly planktonic prey including thaliaceans, mollusks, crustaceans, coelenterates, polychaetes, small fishes, and ctenophores (NOAA 1999h).

8.3.4.4.3 Summer Flounder

EFHs for the juvenile and adult stages of summer flounder are present near the location of the proposed outfall and EFHs for the larvae, juvenile, and adult stages are present in the Inland Bays (NOAA 2011). Summer flounder extend from Nova Scotia to Florida, with the center of abundance within the Mid-Atlantic

Bight from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Adult and juvenile summer flounder inhabit shallow coastal and estuarine waters during the summer and remain offshore during the fall and winter (NOAA 1999i).

North of Cape Hatteras, the EFH for summer flounder larvae is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where summer flounder larvae are collected in the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) survey. Inshore, the EFH for larvae is all the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the Estuarine Living Marine Resources (ELMR) database, in the "mixing" (defined in ELMR as 0.5 to 25.0 ppt) and "seawater" (defined in ELMR as greater than 25 ppt) salinity zones. In general, summer flounder larvae are most abundant nearshore (12 to 50 miles (19 to 80 km) from shore) at depths of 30 to 230 ft (9 to 70 m). They are most frequently found in the northern part of the Mid-Atlantic Bight from September to February, and in the southern part from November to May (NOAA 1998).

North of Cape Hatteras, the EFH for summer flounder juveniles is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where juvenile summer flounder are collected in the NEFSC trawl survey. Inshore, the EFH for juveniles is all of the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 37°F (3°C) and salinities from 10 to 30 ppt range (NOAA 1998).

North of Cape Hatteras, the EFH for summer flounder adults is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where adult summer flounder are collected in the NEFSC trawl survey. Inshore, the EFH for adults is the estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer Continental Shelf at depths of 500 ft (152 m) in colder months (NOAA 1998).

Juvenile and adult summer flounder are opportunistic feeders, preying mostly on fish and crustaceans. The diet of adult summer flounder include windowpane, winter flounder, northern pipefish, Atlantic menhaden, bay anchovy, red hake, silver hake, scup, Atlantic silverside, American sand lance, bluefish, weakfish, mummichog, rock crabs, squids, shrimps, small bivalve and gastropod mollusks, small crustaceans, marine worms and sand dollars (NOAA 1999i).

8.3.4.4.4 Scup

EFHs for the juvenile and adult stages of scup are present near the location of the proposed outfall and in the Inland Bays (NOAA 2011). Scup have been observed as far north as Canada and as far south as Florida; however, the species primarily occupies the area between Massachusetts and South Carolina

(NOAA 1999j). During the summer and early fall, juvenile and adult scup are common in coastal areas and larger estuaries (NOAA 1999j).

The EFH for scup juveniles is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where juvenile scup are collected in the NEFSC trawl survey. Inshore, the EFH for juveniles is the estuaries where scup are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Juvenile scup, in general during the summer and spring are found in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel and eelgrass bed type substrates and in water temperatures greater than 45°F (7°C) and salinities greater than 15 ppt (NOAA 1998).

The EFH for scup adults is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where adult scup are collected in the NEFSC trawl survey. Inshore, EFH for adults is the estuaries where scup were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45°F (7°C) (NOAA 1998).

Juvenile scup feed primarily on polychaetes, epibenthic amphipods and other small crustaceans, mollusks, and fish eggs and larvae. Adult scup are also benthic feeders and forage on a variety of prey, including small crustaceans (including zooplankton), polychaetes, mollusks, small squid, vegetable detritus, insect larvae, hydroids, sand dollars, and small fish (NOAA 1999j).

8.3.4.4.5 Black Sea Bass

EFHs for the larvae, juvenile, and adult stages of summer flounder are present near the location of the proposed outfall, and an EFH for the juvenile stage is present in the Inland Bays (NOAA 2011). Black sea bass range from Nova Scotia to southern Florida into the Gulf of Mexico and are typically found in complex habitats such as reefs and shipwrecks (NOAA 1999k). In the Mid-Atlantic Bight, juveniles and adults migrate from nearshore habitats to wintering habitats on the outer continental shelf (NOAA 2007).

North of Cape Hatteras, the EFH for black sea bass larvae is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all ranked ten-minute squares of the area where black sea bass larvae are collected in the MARMAP survey. The EFH for larvae is also estuaries where black sea bass were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, the habitats for the transforming (to juveniles) larvae are near the coastal areas and into marine parts of estuaries between Virginia and New York. When larvae become demersal, they are generally found on structured inshore habitat such as sponge beds (NOAA 1998).

The EFH for black sea bass juveniles is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked squares of the area where juvenile black sea bass are collected in the NEFSC trawl survey. Inshore, the EFH for juveniles is the estuaries where black sea bass are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring. Generally, juvenile black sea bass are found in waters warmer than 43°F (6°C) with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Juvenile black sea bass are usually found in association with rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas; offshore clam beds and shell patches may also be used during the wintering (NOAA 1998).

The EFH for black sea bass adults is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where adult black sea bass are collected in the NEFSC trawl survey. Inshore, the EFH for adults is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43°F (6°C) seem to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are usually the substrate preference (NOAA 1998).

Larvae black sea bass prey on microalgae and zooplankton. Juveniles prey on benthic and epibenthic crustaceans (isopods, amphipods, small crabs, sand shrimp, copepods, mysids) and small fish. Adult black sea bass feed on a variety of infaunal and epibenthic invertebrates, especially crustaceans (including juvenile American lobster, crabs, and shrimp) small fish, and squid (NOAA 2007).

8.3.4.4.6 Surf Clam

The EFH for only the juvenile stage of surf clam is present near the location of the proposed outfall (NOAA 2011). Atlantic surfclams in the western North Atlantic extend from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina, with major concentrations found on Georges Bank, south of Cape Cod, and off Long Island, southern New Jersey, and the Delmarva Peninsula (NOAA 1999l). As a bivalve mollusk, surf clams do not migrate.

The EFH for surf clam adults is throughout the substrate, to a depth of three feet (one meter) below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys. Surfclams generally occur from the beach zone to a depth of about 200 ft (61 m), but beyond about 125 ft (38 m) abundance is low (NOAA 1998).

Atlantic surfclams are planktivorous siphon feeders, and their diet has been observed to include a variety of diatoms as well as ciliates (NOAA 1999l).

8.3.4.4.7 Spiny Dogfish

The EFH for only the adult stage of spiny dogfish is present near the location of the proposed outfall (NOAA 2011). A coastal shark, the spiny dogfish ranges from Labrador to Florida, but is most abundant from Nova Scotia to Cape Hatteras, North Carolina. North and south migration is primary, but inshore and offshore migration also occurs (NOAA 2007a).

North of Cape Hatteras, the EFH for spiny dogfish adults is the waters of the Continental shelf from the Gulf of Maine through Cape Hatteras, North Carolina in areas that encompass the highest 90% of all ranked ten-minute squares for the area where adult dogfish were collected in the NEFSC trawl surveys. Inshore, EFH for adults is the "seawater" portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, adult dogfish are found at depths of 33 to 1,476 ft (10 to 450 m) in water temperatures ranging between 37°F (3°C) and 82°F (28°C) (NOAA 1998).

Spiny dogfish have been observed to prey on fish, squid, and ctenophores as well as flatfishes, blennies, sculpins, capelin, ctenophores, jellyfish, polychaetes, sipunculids, amphipods, shrimps, crabs, snails, octopods, and feet sea cucumbers (NOAA 2007a).

8.3.4.5 South Atlantic Essential Fish Habitat Species

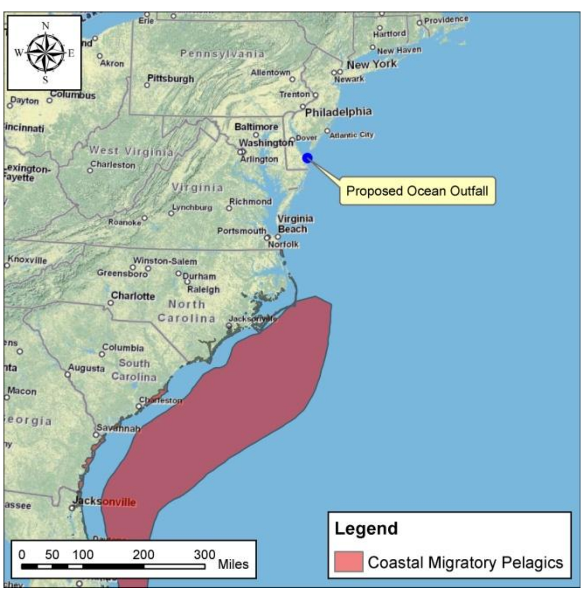
8.3.4.5.1 King Mackerel

EFHs for the egg, larvae, juvenile, and adult stages of king mackerel are present near the location of the proposed outfall and in the Inland Bays (NOAA 2011). The EFH for king mackerel occurs in the South Atlantic and Mid-Atlantic Bights.

King mackerel is a coastal migratory pelagic species. EFHs for coastal migratory pelagic species includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone (NOAA 1998).

The EFH for king mackerels and other coastal migratory pelagic species is presented in Figure 8-16.

Figure 8-16 Essential Fish Habitat for coastal migratory pelagic species including king mackerel, Spanish mackerel, and cobia



8.3.4.5.2 Spanish Mackerel

EFHs for the egg, larvae, juvenile, and adult stages of spanish mackerel are present near the location of the proposed outfall and in the Inland Bays (NOAA 2011). The EFH for Spanish mackerel occurs in the South Atlantic and Mid-Atlantic Bights.

Spanish mackerel is a coastal migratory pelagic species. EFHs for coastal migratory pelagic species includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone (NOAA 1998).

The EFHs for Spanish mackerels and other coastal migratory pelagic species is also presented in Figure 8-16.

8.3.4.5.3 Cobia

EFHs for the egg, larvae, juvenile, and adult stages of cobia are present near the location of the proposed outfall and in the Inland Bays (NOAA 2011). EFHs for cobia occurs in the South Atlantic and Mid-Atlantic Bights.

Cobia is a coastal migratory pelagic species. EFHs for coastal migratory pelagic species includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone (NOAA 1998). The EFH for cobia also includes high salinity bays, estuaries, and seagrass habitat and the Gulf Stream is an EFH because it provides a mechanism to disperse coastal migratory pelagic larvae (NOAA 1998).

The EFHs for cobia and other coastal migratory pelagic species is also presented in Figure 8-16.

8.3.4.6 Highly Migratory Essential Fish Habitat Species

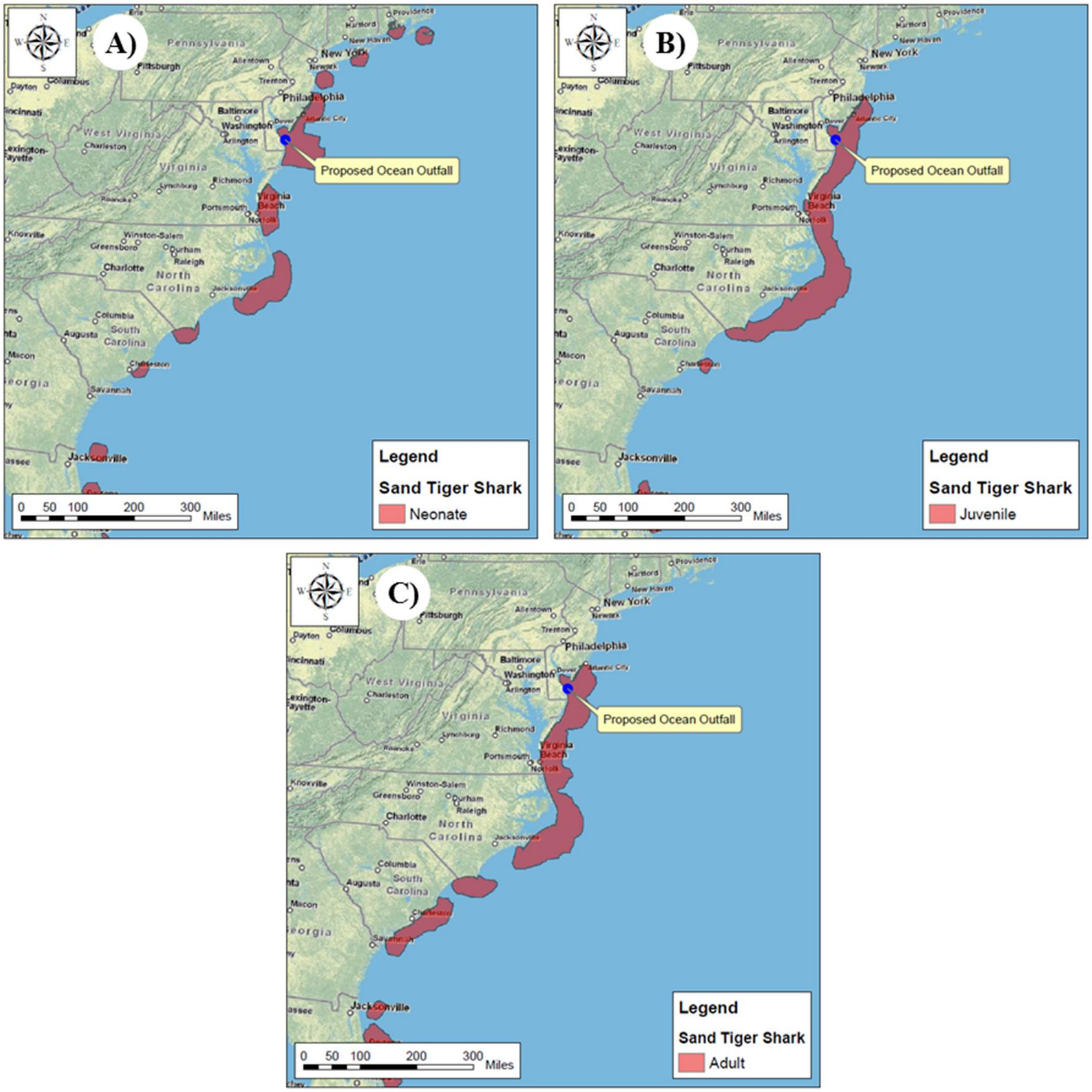
8.3.4.6.1 Sand Tiger Shark

EFHs for the neonate, juvenile, and adult stages of sand tiger shark are present near the location of the proposed outfall (NOAA 2011).

The EFH for neonate/early juvenile sand tiger sharks is shallow coastal waters from Barnegat Inlet, NJ south to Cape Canaveral, FL to the 82 ft (25 m) isobaths (NOAA 1998). The EFH for late juvenile/subadult sand tiger sharks is not well known at this time (NOAA 1998). The EFH for adult sand tiger sharks is shallow coastal waters to the 82 ft (25 m) isobath from Barnegat Inlet, NJ to Cape Lookout and from St. Augustine to Cape Canaveral, FL (NOAA 1998).

The EFHs for neonate, juvenile, and adult sand tiger sharks are presented in Figure 8-17.

Figure 8-17 Sand Tiger Shark Essential Fish Habitat for A) Neonates, B) Juveniles, and C) Adults (NOAA 2011a)



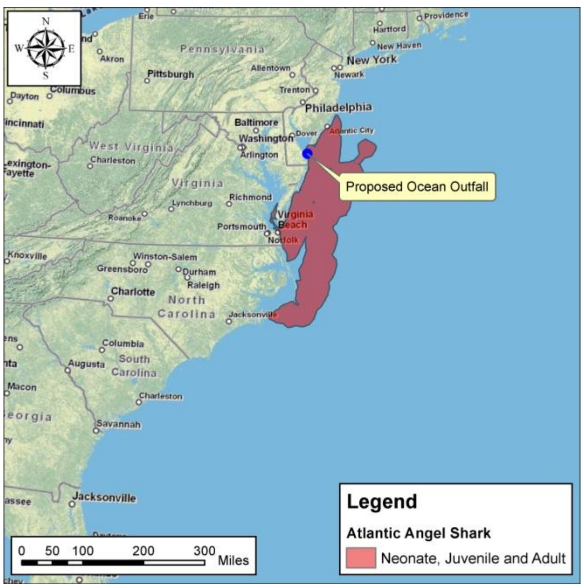
8.3.4.6.2 Atlantic Angel Shark

The EFH for the neonate, juvenile, and adult stages of Atlantic angel shark is present near the location of the proposed outfall (NOAA 2011).

The EFHs of all life stages of the Atlantic angel shark are off the coast of southern New Jersey, Delaware, and Maryland from 39 °N to 38 °N, in shallow coastal waters out to the 82 ft (25 m) isobath, including the mouth of Delaware Bay.

The EFHs for neonate, juvenile, and adult Atlantic angel sharks are presented in Figure 8-18.

Figure 8-18 Atlantic Angel Shark Essential Fish Habitat for Neonates, Juveniles and Adults (NOAA 2011a)



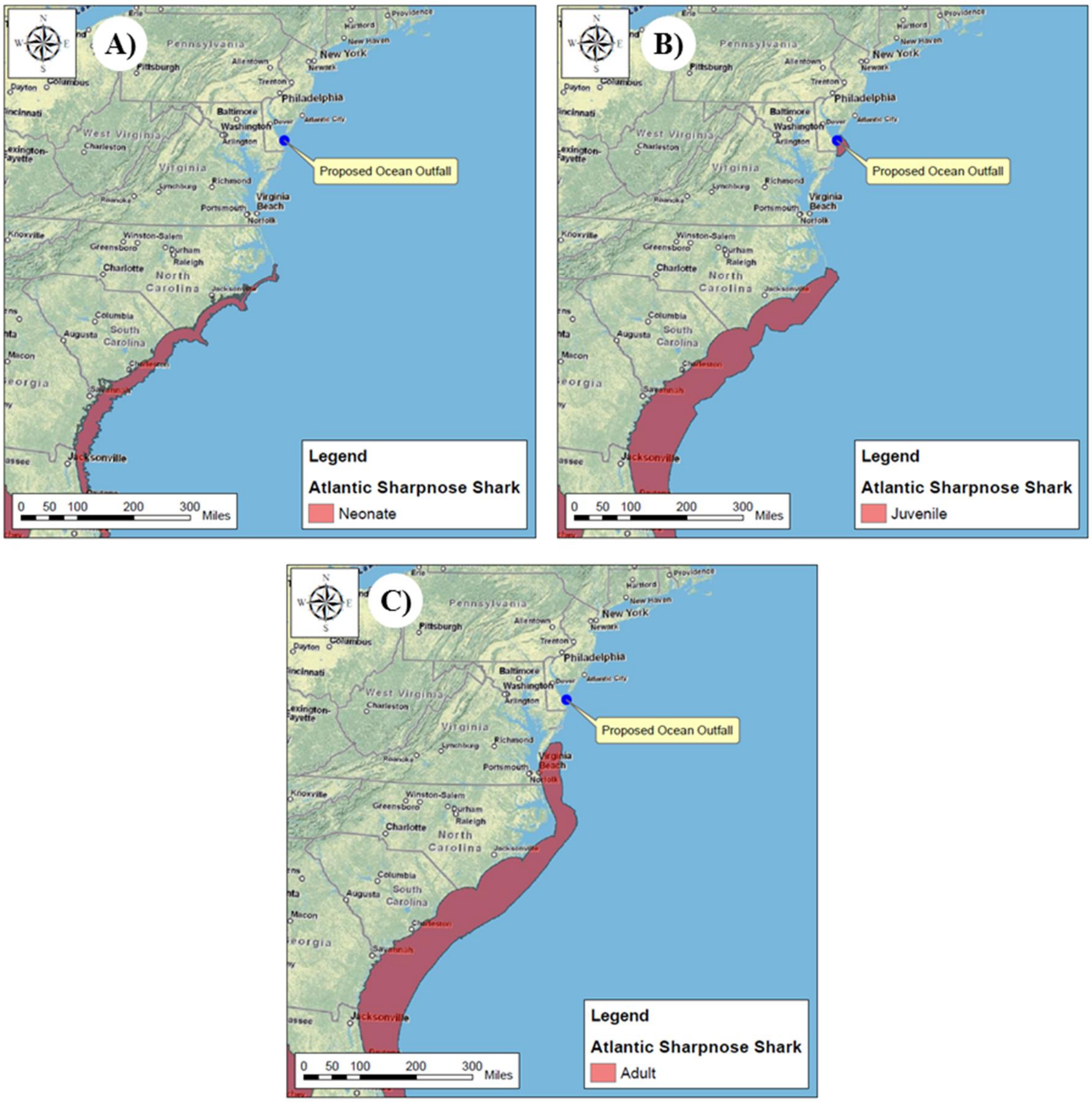
8.3.4.6.3 Atlantic Sharpnose Shark

The EFH for the adult stage of Atlantic sharpnose shark is present near the location of the proposed outfall (NOAA 2011).

The EFH for adult Atlantic angel shark extends from Cape May, NJ south to the North Carolina/ South Carolina border. The EFH includes shallow coastal areas north of Cape Hatteras, NC to the 82 ft (25 m) isobath; south of Cape Hatteras between the 82 and 328 ft (25 and 100 m) isobaths; offshore St. Augustine, FL to Cape Canaveral, FL from inshore to the 328 ft (100 m) isobath, Mississippi Sound from Perdido Key to the Mississippi River Delta to the 164 ft (50 m) isobath; coastal waters from Galveston to Laguna Madre, TX to the 164 ft (50 m) isobaths

The EFHs for neonate, juvenile, and adult sand tiger sharks are presented in Figure 8-19.

Figure 8-19 Atlantic Sharpnose Shark Essential Fish Habitat for A) Neonates, B) Juveniles, and C) Adults (NOAA 2011a)



8.3.4.6.4 Dusky Shark

The EFHs for the neonate, juvenile and adult stages of dusky shark are present near the location of the proposed outfall (NOAA 2011).

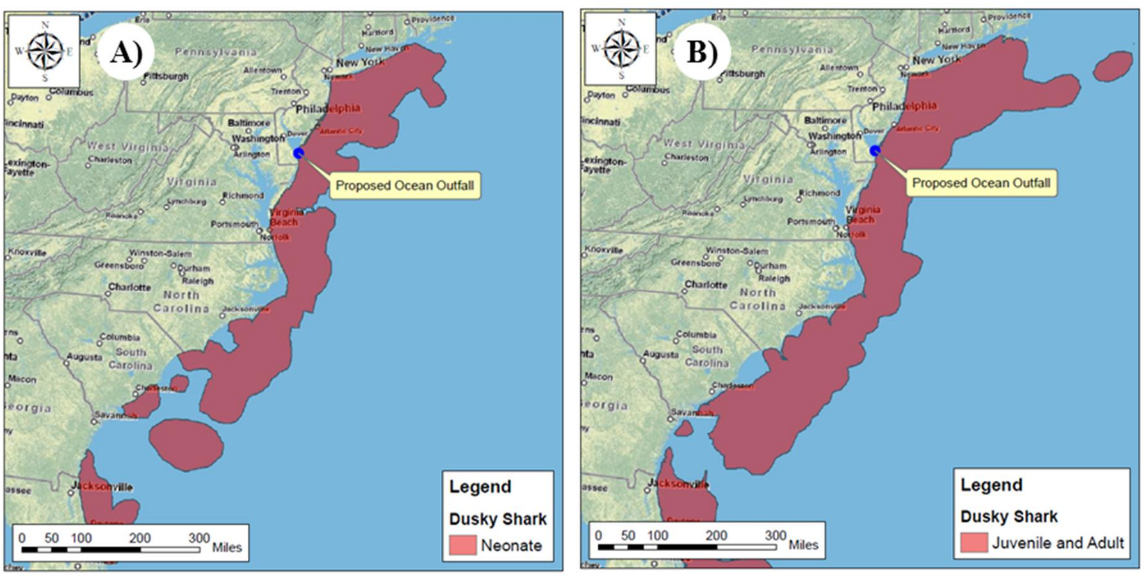
The EFH for neonate/early juvenile dusky sharks is shallow coastal waters, inlets and estuaries to the 82 ft (25 m) isobath from the eastern end of Long Island, NY at 72° W south to Cape Lookout, NC at 34.5° N; from Cape Lookout south to West Palm Beach, FL (27.5° N), shallow coastal waters, inlets and estuaries and offshore areas to the 328 ft (100 m) isobath.

The EFH for late juvenile/subadult dusky sharks is off the coast of southern New England from 70° W west and south, coastal and pelagic waters between the 82 and 656 ft (25 and 200 m) isobaths; shallow coastal waters, inlets and estuaries to the 200 m isobath from Assateague Island at the Virginia/Maryland border (38° N) to Jacksonville, FL at 30° N; shallow coastal waters, inlets and estuaries to the 1641 ft (500 m) isobath continuing south to the Dry Tortugas, FL at 83° W.

The EFH for late adult dusky sharks is pelagic waters offshore the Virginia/North Carolina border at 36.5° south to Ft. Lauderdale, FL at 28° N between the 82 and 656 ft (25 and 200 m) isobaths.

The EFHs for neonate, juvenile, and adult dusky sharks are presented in Figure 8-20.

Figure 8-20 Dusky Shark Essential Fish Habitat for A) Neonates, B) Juveniles and Adults (NOAA 2011a)



8.3.4.6.5 Sandbar Shark

EFHs for the neonate, juvenile, and adult stages of sandbar shark are present near the location of the proposed outfall (NOAA 2011). Habitat areas of particular concern (HAPC) for all three life stages are also present near the outfall.

The EFH for neonate/early juvenile sandbar sharks is shallow coastal areas to the 82 ft (25 m) isobath from Montauk, Long Island, NY at 72° W, south to Cape Canaveral, FL at 80.5° W (all year); nursery areas in shallow coastal waters from Great Bay, NJ to Cape Canaveral, FL, especially Delaware and Chesapeake Bays (seasonal-summer); also shallow coastal waters to up to a depth of 50 m on the west coast of Florida and the Florida Keys from Key Largo at 80.5° W north to south of Cape San Blas, FL at 85.25° W. Typical parameters: salinity-greater than 22 ppt; temperatures-greater than 21° C.

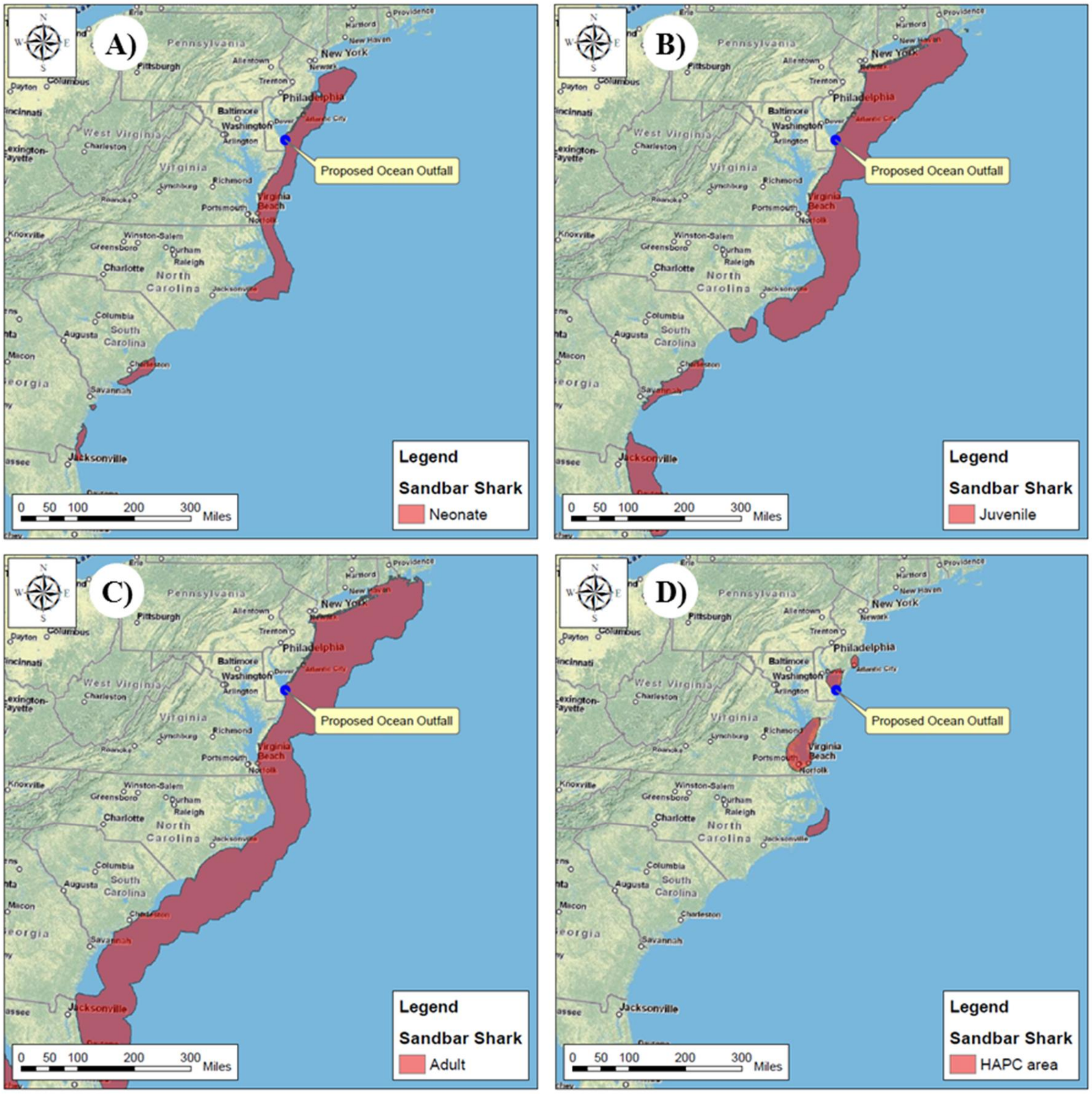
The EFH for Late juvenile/subadult sandbar sharks is offshore southern New England and Long Island, all waters, coastal and pelagic, north of 40° N and west of 70° W; also, south of 40° N at Barnegat Inlet, NJ, to Cape Canaveral, FL (27.5° N), shallow coastal areas to the 82 ft (25 m) isobath; also, in the winter, from 39° N to 36° N, in the Mid-Atlantic Bight, at the shelf break, benthic areas between the 328 and 656 ft (100 and 200 m) isobaths; also, on the west coast of Florida, from shallow coastal waters to the 164 ft (50 m) isobath, from Florida Bay and the Keys at Key Largo north to Cape San Blas, FL at 85.5° W.

The EFH for Adult sandbar sharks is on the east coast of the United States, shallow coastal areas from the coast to the 164 ft (50 m) isobath from Nantucket, MA, south to Miami, FL; also, shallow coastal areas from the coast to the 328 ft (100 m) isobath around peninsular Florida to the Florida panhandle at 85.5° W, near Cape San Blas, FL including the Keys and saline portions of Florida Bay.

The HAPC for sandbar sharks are the important nursery and pupping grounds that have been identified in shallow areas and the mouth of Great Bay, NJ, lower and middle Delaware Bay, lower Chesapeake Bay, MD and near the Outer Banks, NC, in areas of Pamlico Sound adjacent to Hatteras and Ocracoke Islands and offshore those islands.

The EFHs for neonate, juvenile, and adult sandbar sharks are presented in Figure 8-21.

Figure 8-21 Sandbar Shark Essential Fish Habitat for A) Neonates, B) Juveniles, and C) Adults; and D) Habitat Areas of Particular Concern (NOAA 2011a)



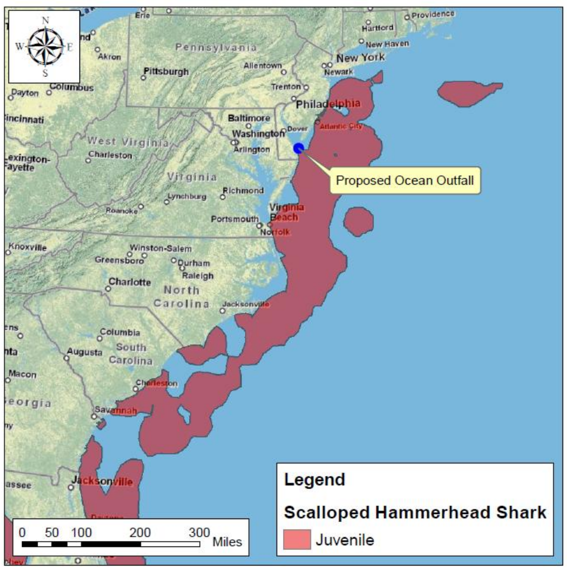
8.3.4.6.6 Scalloped Hammerhead Shark

The EFH for the juvenile stage of scalloped hammerhead shark is present near the location of the proposed outfall (NOAA 2011).

The EFH for late juvenile/subadult scalloped hammerhead sharks is all shallow coastal waters of the U.S. Atlantic seaboard from the shoreline to the 656 ft (200 m) isobath from 39° N, south to the vicinity of the Dry Tortugas and the Florida Keys at 82° W; also in the Gulf of Mexico, in the area of Mobile Bay, AL and Gulf Islands National Seashore, all shallow coastal waters from the shoreline out to the 164 ft (50 m) isobath.

The EFH for juvenile scalloped hammerhead sharks is presented in Figure 8-22

Figure 8-22 Scalloped Hammerhead Shark Essential Fish Habitat for Juveniles (NOAA 2011a)



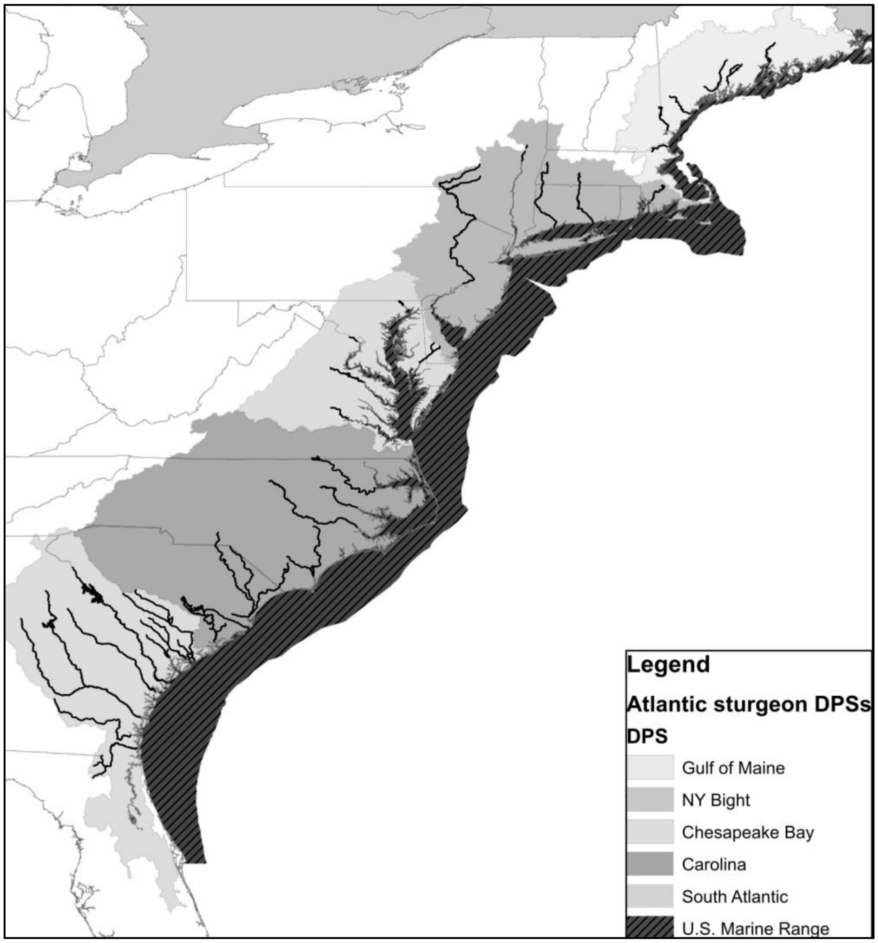
8.3.4.6A Endangered Species

8.3.4.6A.1 Atlantic Sturgeon

The Atlantic sturgeon is an anadromous fish with a habitat spanning most of the eastern coast of the United States (NOAA 2012). Spawning adults migrate upriver in spring, beginning in February-March in the south, April-May in the mid-Atlantic, and May-June in Canadian waters. Spawning occurs in flowing water between the salt front and fall line of large rivers. Juveniles move downstream and inhabit brackish waters for a few months and when they reach a size of about 30 to 36 inches (76-92 cm) they move into nearshore coastal waters. Atlantic sturgeons are benthic feeders and typically forage on crustaceans, worms, and mollusks. The Atlantic sturgeon is divided into five distinct population segments. Under the Endangered Species Act, The Chesapeake Bay, New York Bight, Carolina, and South Atlantic populations of Atlantic sturgeon are listed as endangered, while the Gulf of Maine population is listed as threatened.

The ranges of each distinct population segment of the Atlantic sturgeon are presented in Figure 8-22A.

Figure 8-22A Approximate Ranges of Atlantic sturgeon Distinct Population Segments (NOAA 2012)



8.3.4.7 Short Term / Temporary Impacts

8.3.4.7.1 No Action

The no action alternative would involve no new construction, thus there would be no short term impact on fish habitats.

8.3.4.7.2 Land Application

There will be no short term impacts to fish from the land application alternative, as no construction will occur in any aquatic environments.

8.3.4.7.3 Ocean Outfall

Construction of the diffuser and portions of outfall pipe would require dredging, which could potentially impact fish populations. The potential risks to fish include physical injury either directly by physical contact or indirectly by disrupting the food resources. It is also possible that dredging for the outfall could temporarily increase turbidity.

Significant impacts to EFHs are not expected. As detailed in Sections 8.3.4.3 through 8.3.4.6 of this report, all of the fish species associated with the area of concern are highly mobile and migratory, and all EFHs near the project extend far beyond the area. Thus construction activity will, at most, only disturb a small fraction of the total EFH area.

8.3.4.8 Long Term / Chronic Impacts

8.3.4.8.1 No Action

The No Action Alternative will continue to contribute to the eutrophication of this body of water, which lowers the amount of dissolved oxygen within the water. Decline and loss of fish habitats due to low dissolved oxygen is "one of the most severe problems associated with eutrophication of coastal waters" (Deegan and Buchsbaum 2005).

8.3.4.8.2 Land Application

Effluent is not disposed into any aquatic environment in the land application alternative, so the alternative will have no long term or chronic impacts to fish.

8.3.4.8.3 Ocean Outfall

Long term impacts on fisheries from construction activity are connected to the rate and success of benthic recolonization (Diaz, Cutter Jr and Hobbs III 2004). These impacts are expected to be minimal because the benthic organisms are expected to completely recover within three months to a few years (Scott 2001).

The ocean outfall will not lead to eutrophication since the small concentrations of nutrients and other water quality parameters within the effluent would be rapidly diluted to background levels. Dissolved oxygen around the outfall is not expected to drop, and thus fish kills from depleted oxygen will not be caused by the outfall. Significant changes to the benthic communities are not expected, so impacts to fish habitats are expected to be minimal. Since the effluent is disinfected at the treatment plant, infection of fish with anthropogenically-derived pathogens is not expected.

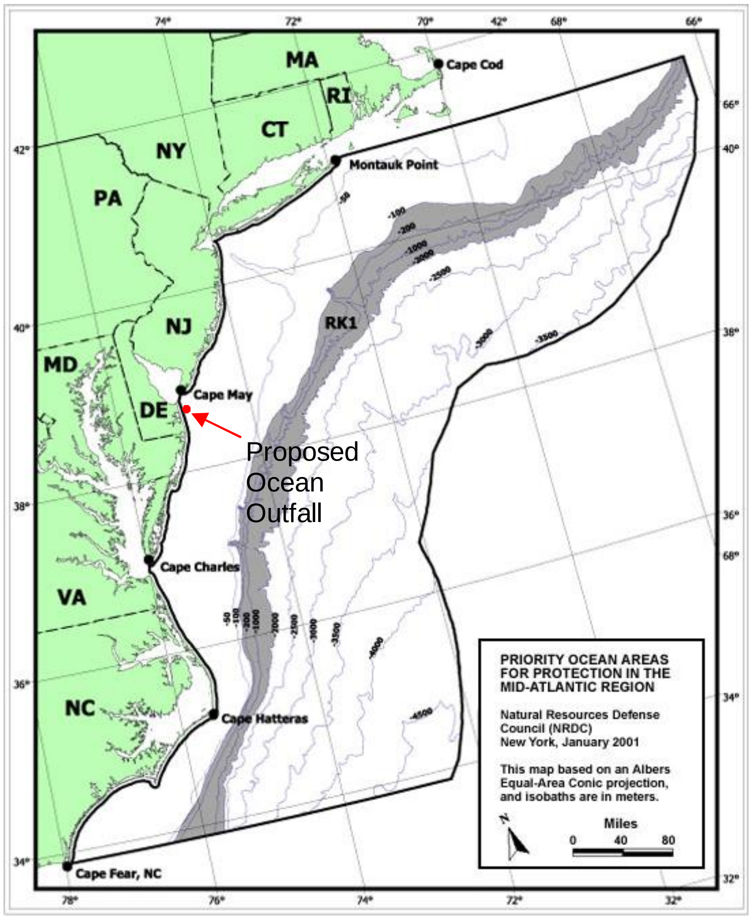
As detailed in Sections 8.3.4.3 through 8.3.4.6 of this report, all of the fish species associated with the area of concern are highly mobile and migratory, and all EFHs near the project extend far beyond the area. Thus, exposure to any contaminant is expected to be transient and minimal. As stated previously, any contaminant potentially present is rapidly diluted to below minimum water quality standards or to non-detectable levels (see Chapter 6).

8.3.5 Marine Mammals

8.3.5.1 Marine Mammal Environment

Marine mammals in the North Atlantic off the coast of the United States include whales, dolphins, porpoises, and seals. The highest diversity of marine mammals in the Mid-Atlantic region occurs between depths of 330 to 6,560 feet (100 and 2,000 m) (Kenney 2000), which, as shown in Figure 8-23, is over 50 miles (80 km) away from the location of the proposed outfall.

Figure 8-23 Highest diversity of marine mammals in the U.S. mid-Atlantic (Kenney 2000)



Mammal species observed in the vicinity of the outfall include harbor, gray, harp, and hooded seals; bottlenose dolphins; harbor porpoises; and humpback, fin, and right whales (Waring, et al. 2009) (E. Stetzar, Comments Rehoboth Beach Ocean Outfall Environmental Impact Statement-May 2011 draft 2011a) (Thurman 2012).

From 2000 to 2011, 496 marine mammal strandings were recorded by the MERR Institute (Thurman 2012). A breakdown by species and year is presented in Table 8-8A.

Table 8-8A Marine Mammal Strandings (Thurman 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Cetaceans													
Bottlenose dolphin	13	6	13	21	17	9	10	15	26	13	11	13	167
Harbor porpoise	3	4	3	1	1	4	3	3	4	2	3	0	31
Common dolphin	1	1	1	1	2	0	0	0	2	3	0	2	13
Striped dolphin	0	1	0	5	0	0	0	1	0	0	0	0	7
Rough toothed dolphin	0	1	0	0	0	0	0	0	0	0	0	0	1
Rissos Dolphin	0	0	0	0	1	2	0	1	0	0	0	0	4
Unidentified dolphin	0	0	0	0	0	0	1	0	0	0	0	0	1
Humpback whale	0	0	1	1	1	0	0	0	0	0	0	0	3
Minke whale	0	1	0	0	0	0	0	0	0	1	0	1	3
White sided dolphin	0	0	0	0	0	0	1	0	1	1	0	2	5
Pygmy Sperm Whale	0	0	0	0	0	0	2	2	0	0	0	0	4
Short finned Pilot Whale	0	0	0	0	0	0	0	0	0	1	0	0	1
Fin Whale	0	0	0	0	0	0	1	0	0	1	2	0	4
Northern Right Whale	0	0	0	0	0	0	0	2	0	0	1	1	4
Northern Bottlenose Whale	0	0	0	0	0	0	2	0	0	0	0	0	2
Sei Whale	0	0	0	0	0	0	0	0	0	1	0	0	1
Unidentified Whale	2	0	0	0	0	1	1	0	2	0	1	0	7
Pinnipeds													
Harbor seal	0	40	0	3	1	13	15	5	3	7	4	18	109
Harp seal	0	1	1	2	4	5	6	7	13	1	4	7	51
Hooded seal	0	1	1	0	2	0	3	0	0	0	0	0	7

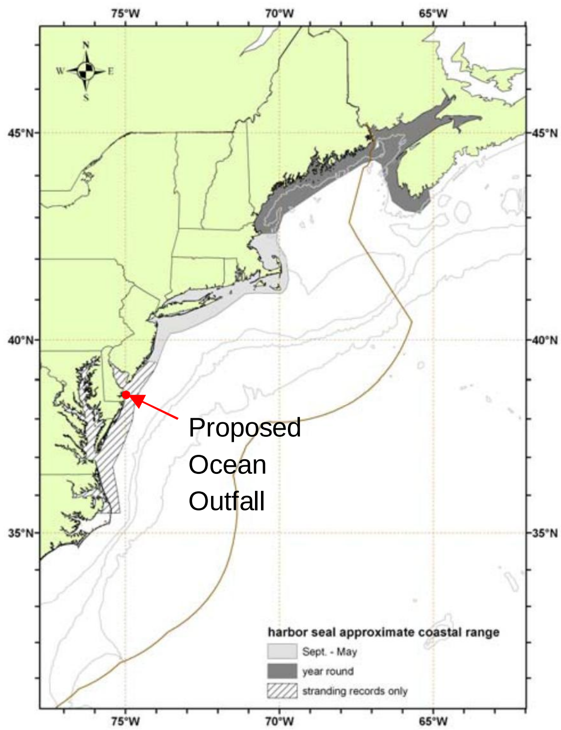
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Gray seal	0	2	0	1	1	5	1	6	6	3	8	8	41
Unidentified Pinniped	0	1	0	0	0	0	2	10	9	2	3	0	27
Sirenia													
Manatee	0	0	0	0	1	0	1	0	0	1	0	0	3
Total	19	59	20	35	31	39	49	52	66	37	37	52	496

8.3.5.1.1 Harbor Seal

The harbor seal (*Phoca vitulina*) is typically found year-round north of southern New England and New York. Harbor seals typically migrate south to waters off the coast of Delaware from November to May (Waring, et al. 2009), and annual occurrences have been documented in the area since the mid-1980s (E. Stetzar 2011a).

Seal sightings off the coast of Delaware are not well documented, but the presence of seals can be inferred by stranding data, which is well recorded. A stranding refers to when either a living or dead “marine mammal or sea turtle comes ashore due to an illness, injury or some other deleterious factor” (E. Stetzar 2000). From 2000 to 2011, 235 seal strandings were reported in Delaware, of which 109 were identified as harbor seals (Thurman 2012). Harbor seals are not listed as threatened or endangered under the Endangered Species Act. The range of harbor seals as identified in the NOAA National Marine Fisheries Service Stock Assessment Report is shown in Figure 8-24. Although the map classifies the area around the outfall as “stranding records only”, annual occurrences are well documented and it is assumed that harbor seals are in the vicinity of the project area during winter months (E. Stetzar 2011a).

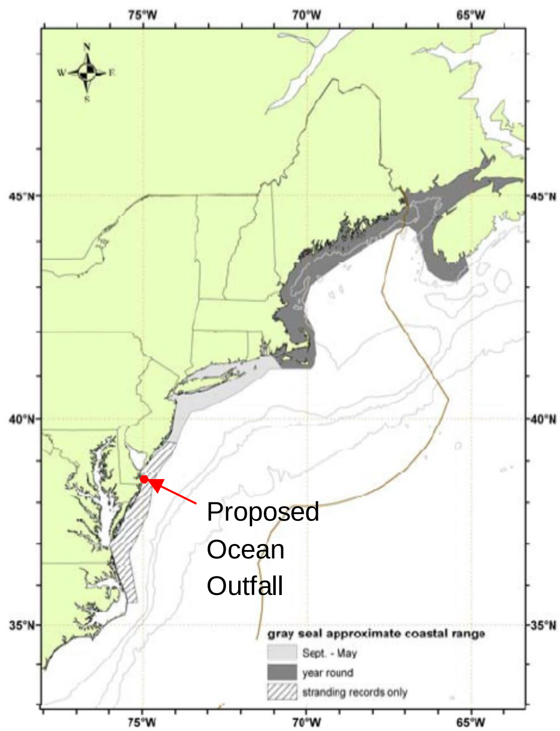
Figure 8-24 Approximate coastal range of harbor seals (Waring, et al. 2009)



8.3.5.1.2 Gray Seal

The gray seal (*Halichoerus grypus*) population in the western North Atlantic mainly extends from Labrador, Canada to New York (Waring, et al. 2009). However, gray seal stranding mortalities, have been recorded in all US coastal states north of North Carolina, including off the coast of Delaware, which would indicate that gray seals are present near the location of the proposed outfall. From 2000 to 2011, 235 seal strandings were reported in Delaware, of which 41 were identified as gray seals (Thurman 2012). Gray seals are not listed as threatened or endangered under the Endangered Species Act. The range of gray seals as identified in the NOAA National Marine Fisheries Service Stock Assessment Report is shown in Figure 8-25. Although the map classifies the area around the outfall as “stranding records only”, annual occurrences are well documented and it is assumed that gray seals are in the vicinity of the project area during winter months (E. Stetzar 2011a).

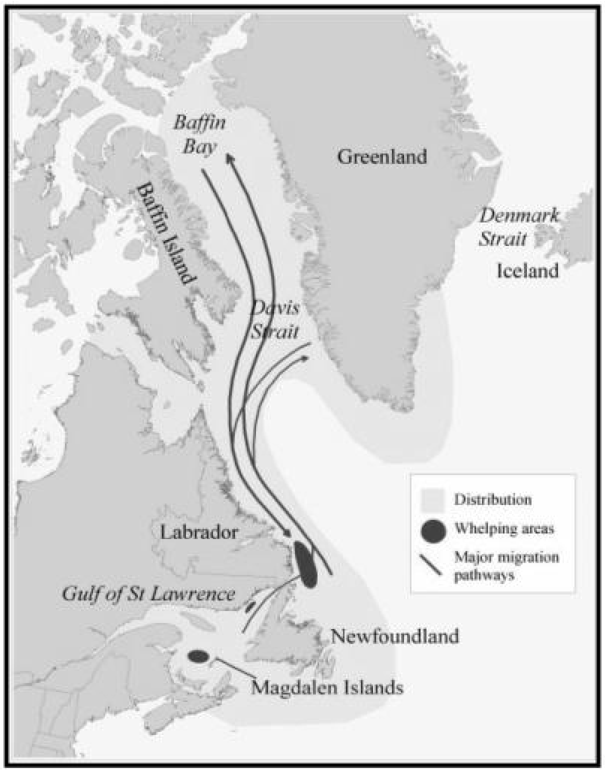
Figure 8-25 Approximate coastal range of gray seals (Waring, et al. 2009)



8.3.5.1.3 Harp Seal

The harp seal (*Pagophilus groenlandicus*) occurs throughout much of the North Atlantic and Arctic Oceans (Waring, et al. 2009). Harp seals are highly migratory, typically whelping in southern waters and moving north to feed. From January to May, harp seal populations extend south to the East Coast of the United States including off the coast of Delaware. From 2000 to 2011, 235 seal strandings were reported in Delaware, of which 51 were identified as harp seals (Thurman 2012). Harp seals are not listed as threatened or endangered under the Endangered Species Act. The range of harp seals as identified in the NOAA National Marine Fisheries Service Stock Assessment Report is shown in Figure 8-26. Although the map does not include the project area, annual occurrences off the coast of Delaware are well documented and it is assumed that harp seals are in the vicinity of the project area during winter months (E. Stetzar 2011a).

Figure 8-26 Harp seal high density area (Waring, et al. 2009)



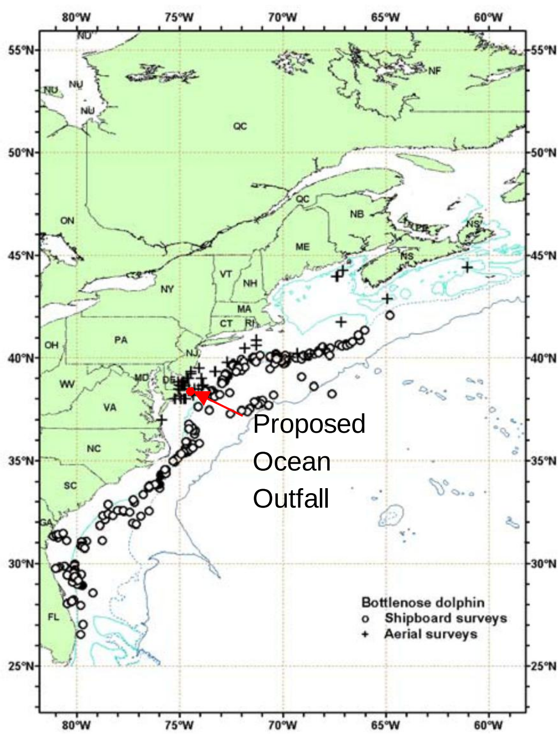
8.3.5.1.4 Hooded Seal

The hooded seal (*Cystophora cristata*) occurs throughout much of the North Atlantic and Arctic Oceans at deeper water farther offshore than harp seal populations (Waring, et al. 2009). Hooded seals are highly migratory and have been observed as far south as Puerto Rico. Appearances occur in New England waters most frequently between January and May, and off the southeastern coast of the United States during summer and fall. From 2000 to 2011, 235 seal strandings were reported in Delaware, of which 7 were identified as hooded seals (Thurman 2012). Hooded seals are not listed as threatened or endangered under the Endangered Species Act.

8.3.5.1.5 Bottlenose Dolphin

The western North Atlantic is host to two different morphotypes of the bottlenose dolphin (Tursiops truncates). The coastal morpohotype is typically found close to shore, and the offshore morphotype is typically found in waters greater than 131 ft (40 m) deep; however, the two morphotypes do overlap to some degree (Waring, et al. 2009). The coastal morphotype, which occurs in the vicinity of the proposed outfall, is continuously distributed from Long Island, NY to the Gulf of Mexico (Waring, et al. 2009). From late spring to late summer, Bottlenose dolphins are observed daily just outside the surf zone off the coast of Delaware and within Delaware Bay. Several calving areas are believed to be outside of and just north of the mouth of Delaware Bay (E. Stetzar 2011). During winter months, bottlenose dolphins migrate south and are rarely observed north of the North Carolina-Virginia border (Waring, et al. 2009). The western North Atlantic offshore bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. Observed bottlenose dolphin sightings during summer NEFSC and Southeast Fisheries Science Center (SEFSC) aerial and shipboard surveys from 1998 to 2006 are presented in Figure 8-27. From 2000 to 2011, 258 cetacean strandings were reported in Delaware, of which 167 were identified as bottlenose dolphins (Thurman 2012).

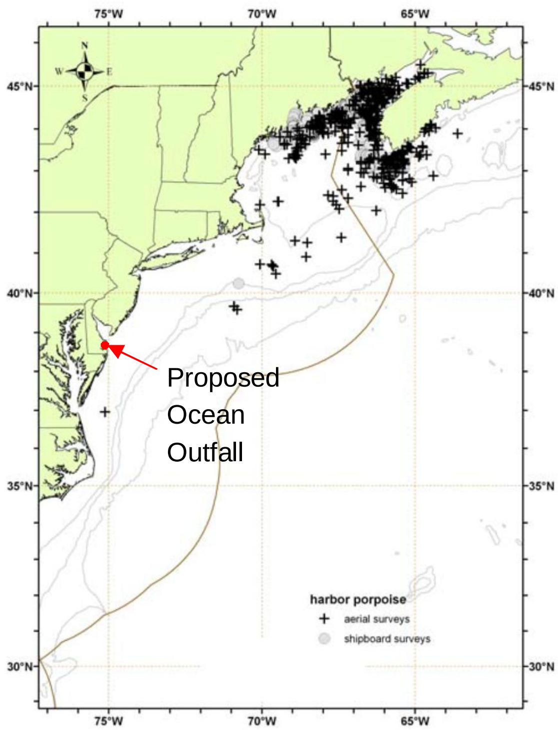
Figure 8-27 Distribution of bottlenose dolphin sightings from NEFSC and SEFSC aerial surveys during the summer in 1998, 1999, 2002, 2004, and 2006 (Waring, et al. 2009)



8.3.5.1.6 Harbor Porpoise

The harbor porpoise (*Phocoena phocoena*) population in the western North Atlantic migrates annually along the coastline. During summer months (July to September), the population is concentrated in the northern Gulf of Maine and Southern Bay of Fundy region (Waring, et al. 2009). When the water is cooler in the fall and spring months (October to December and April to June), the harbor porpoise population is more dispersed, extending primarily from Maine to New Jersey, with lower densities north and south. In winter months, the population extends as far south as North Carolina. The harbor porpoise is not listed as threatened or endangered under the Endangered Species Act. Observed harbor porpoise sightings during summer NEFSC and SEFSC aerial and shipboard surveys from 1998 to 2007 are presented in Figure 8-28. Harbor porpoises are even more likely to occur in Delaware waters during winter months which are not included in the NOAA survey map. From 2000 to 2011, 258 cetacean strandings were reported in Delaware, of which 31 were identified as harbor porpoises (Thurman 2012).

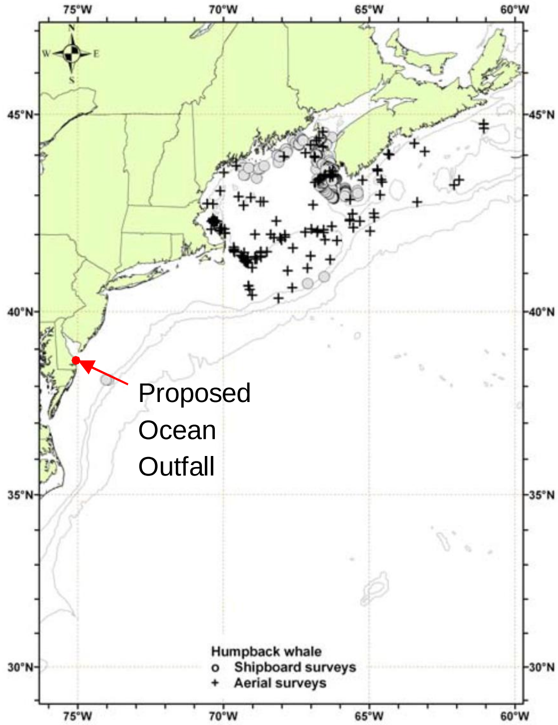
Figure 8-28 Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007 (Waring, et al. 2009)



8.3.5.1.7 Humpback Whale

The humpback whale (*Megaptera novaeangliae*) population of the western North Atlantic feeds during the spring, summer, and fall months along the eastern coast of the United States, the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Waring, et al. 2009). During the winter, the majority of humpback whales from various Atlantic feeding areas mate and calve in the West Indies, though a significant number remain in mid and high-latitude regions, including off the coast of Delaware (Waring, et al. 2009). Humpback whales have been observed close to shore in the Delaware region (E. Stetzar 2011), and whale strandings have been reported in the U.S. mid-Atlantic and southeastern states (Waring, et al. 2009). The humpback whale is listed as an endangered species under the Endangered Species Act. Observed humpback whale sightings during summer NEFSC and SEFSC aerial and shipboard surveys from 1998 to 2007 are presented in Figure 8-29. Humpback whales are even more likely to occur in Delaware waters during winter months which are not included in the NOAA survey map. From 2000 to 2011, 258 cetacean strandings were reported in Delaware, of which three (3) were identified as humpback whales (Thurman 2012).

Figure 8-29 Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 2006, and 2007 (Waring, et al. 2009)

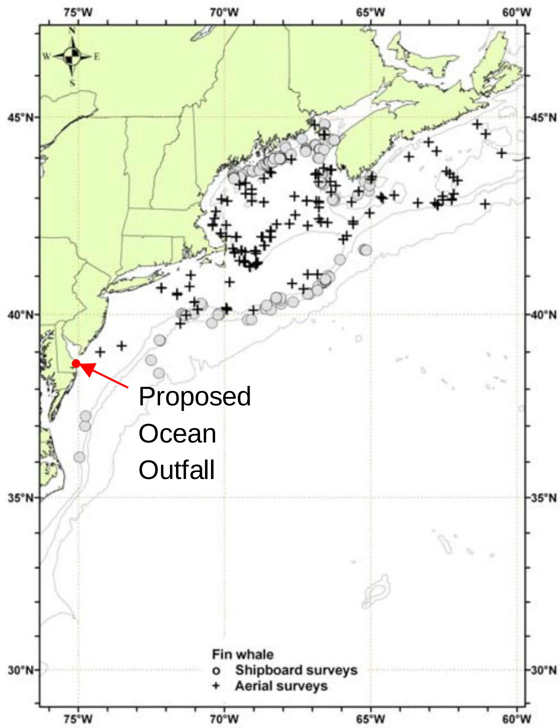


8.3.5.1.8 Fin Whale

Fin whales (*Balaenoptera physalus*) are found off the coast of the eastern United States, Nova Scotia, and the southeastern coast of Newfoundland, primarily from Cape Hatteras northward. In this region, fin whales are likely the dominate large cetacean species as they have the largest standing stock and food requirements. Although not well documented, mid-Atlantic waters may be a critical migration route and/or feeding habitat for this species (E. Stetzar, Comments Rehoboth Beach Ocean Outfall Environmental Impact Statement-May 2011 draft 2011a). The fin whale is listed as an endangered species under the Endangered Species Act.

Observed fin whale sightings during summer NEFSC and SEFSC aerial and shipboard surveys from 1998 to 2007 are presented in Figure 8-30. Fin whales are even more likely to occur in Delaware waters during winter months which are not included in the NOAA survey map. Fin whales have been sighted close to shore in the Delaware region and in the Indian River Inlet (E. Stetzar, Comments Rehoboth Beach Ocean Outfall Environmental Impact Statement-May 2011 draft 2011a). From 2000 to 2011, 258 cetacean strandings were reported in Delaware, of which four (4) were identified as fin whales (Thurman 2012).

Figure 8-30 Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007 (Waring, et al. 2009)

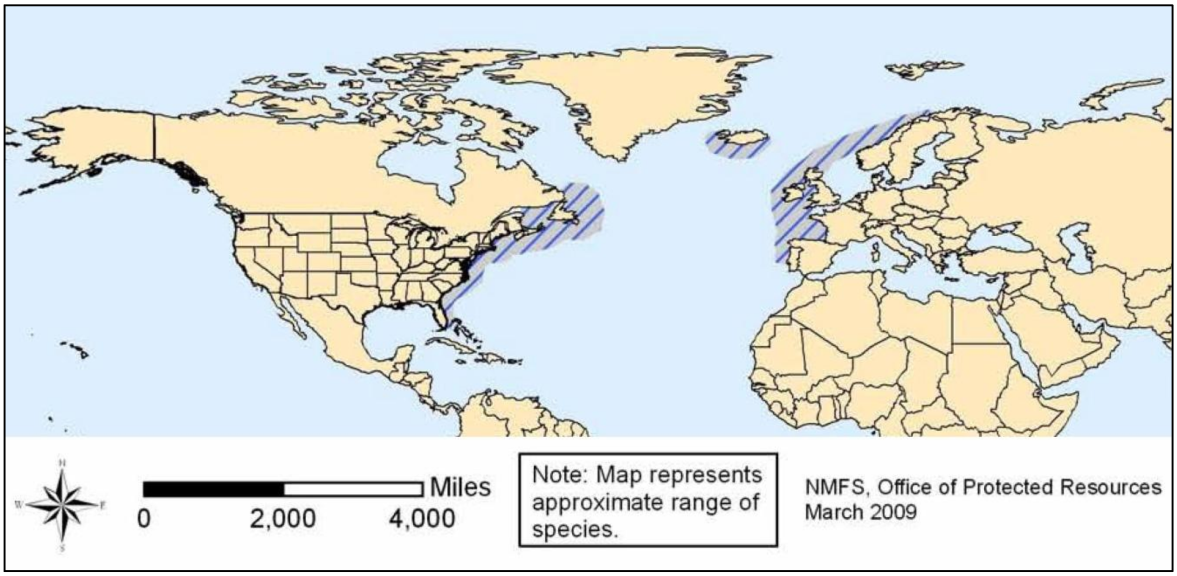


8.3.5.1.9 Right Whale

The North Atlantic right whale (*Eubalaena glacialis*) population ranges from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Funday, Scotian Shelf, and Gulf of St. Lawrence (Waring, et al. 2009). New England waters are an important feeding ground for right whales because they require dense patches of zooplankton in their spring, summer, and fall habitats (Mayo and Marx 1990). Only one stranding of a right whale occurred in Delaware between 1962 and 1998 (E. Stetzar 2000). The Delaware Bay has historically served as feeding and weaning grounds for right whales. Mother/calf pairs have been documented in the vicinity of the Indian River Inlet, and sighted north of this area en route to the Delaware Bay (Thurman 2012). The approximate range of the North Atlantic right whale is presented in Figure 8-30A. From 2000 to 2011, 258 cetacean strandings were reported in Delaware, of which four (4) were identified as North Atlantic right whales (Thurman 2012).

The North Atlantic right whale is listed as endangered under the Endangered Species Act. The minimum population size, as of 2005, is 345 individually recognized whales (Waring, et al. 2009), making it one of the most endangered of all the large whale species (Thurman 2012).

Figure 8-30A Approximate range of North Atlantic Right Whale (NOAA 2012a)



8.3.5.2 Short Term / Temporary Impacts

8.3.5.2.1 No Action

The no action alternative would involve no new construction, thus there would be no short term impact on marine mammals.

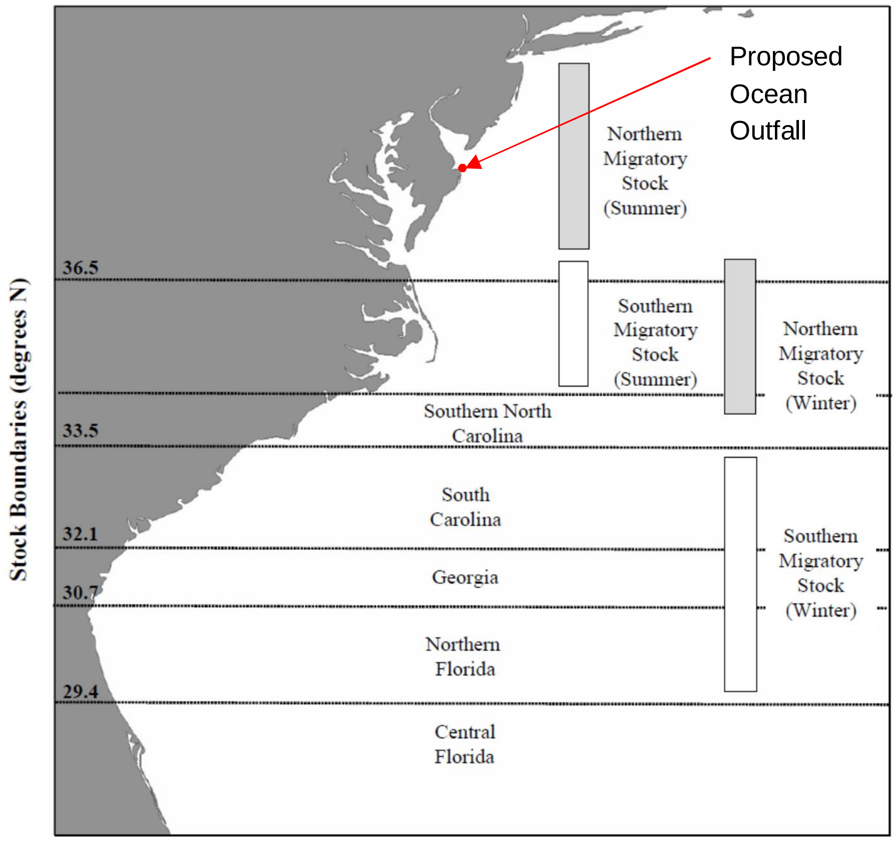
8.3.5.2.2 Land Application

There will be no short term impacts to marine mammals from the land application alternative, as no construction will occur in any aquatic environments.

8.3.5.2.3 Ocean Outfall

Minor impacts may occur to marine mammals during construction of the ocean outfall. Construction during winter months will minimize impact to bottlenose dolphins, since, as shown in Figure 8-31, even the northern migratory stock of coastal bottlenose dolphins has migrated south of the proposed ocean outfall. Conversely, harbor and gray seals migrate into the project area between September and May (as shown in Figure 8-24 and Figure 8-25), and harp and hooded seals follow similar migration patterns. Harbor porpoises, humpback whales, and fin whales are also more prevalent in the project area during winter months. Construction during winter months would thus increase the impact to seal species. No construction will occur on the dunes or beach, so impacts to seals from construction equipment is not expected. The use of equipment that produces bursts of sound/pressure waves can potentially affect the acoustic ability or injure the hearing organs of marine mammals (E. Stetzar 2011). Equipment for construction should be selected to minimize sound intensity and duration.

Figure 8-31 Seasonal distribution and spatial boundaries for prospective stocks of the coastal morphotype of bottlenose dolphin along the Atlantic coast (Waring, et al. 2009)



8.3.5.3 Long Term / Chronic Impacts

8.3.5.3.1 No Action

The no action alternative will have no impact on marine mammals, as disinfected effluent would continue to be discharged into Rehoboth Bay.

8.3.5.3.2 Land Application

Effluent is not disposed into any aquatic environment in the land application alternative, so the alternative will have no long term or chronic impacts to marine mammals.

8.3.5.3.3 Ocean Outfall

Under the ocean outfall alternative, any nutrients or contaminants contained within the effluent would be rapidly dispersed to concentrations below background levels. Effluent is thus not likely to have an adverse impact 50 miles away in the area of high mammal diversity.

The mammal species associated with the area of concern are highly mobile and migratory. Thus, exposure to any contaminant is expected to be transient and minimal. As stated previously, any contaminant potentially present is rapidly diluted to below minimum water quality standards or to non-detectable levels (see Chapter 6). It is unlikely that any bioaccumulation of persistent organic chemicals or heavy metals observed in the Northern Migratory Stock of Atlantic bottlenose dolphins could be attributed to discharge from the RBWWTP (see (Appendix N)). This is due to the advanced secondary treatment at RBWWTP, the lack of industrial waste, and low levels of heavy metals and organic contaminants in the discharge, It is expected that bioaccumulation within other mammal species is unlikely as well.

Dolphin populations from areas with a lower mean salinity have been shown to a higher prevalence and severity of skin lesions in Bottlenose dolphins (Wilson, et al. 1999). As discussed in Section 5.6, salinity equal to that of the ocean surface will be achieved by 1:30 dilution. According to the model presented in Chapter 6, this will be achieved before the end of the near field region in the immediate vicinity of the outfall. Exposure of dolphins to this area of lower salinity would be transient and unlikely to adversely impact the dolphins.

8.4 Endangered Species

8.4.1 Endangered Species in Delaware

All endangered species in Delaware are listed in Table 8-9. In addition, the endangered Atlantic Sturgeon and the endangered humpback, fin, and right whales have been observed off the coast of Delaware. Information on the endangered Atlantic Sturgeon is presented in 8.3.4.6A.1, and potential environmental impacts are detailed in sections 8.3.4.7 and 8.3.4.8. Information on humpback, fin, and right whales is presented in sections 8.3.5.1.7, 8.3.5.1.8, and 8.3.5.1.9 of the marine mammals section, and potential environmental impacts are detailed in sections 8.3.5.2 and 8.3.5.3.

Table 8-9 Endangered Species of Delaware (DNREC 2000)

Category	Common Name	Scientific Name
Birds	Brown Creeper[BR]	*Certhia americana*
	Bald Eagle[T]	*Haliaeetus leucocephalus*
	Pied-billed Grebe[BR]	*Podilymbus podiceps*
	Northern Harrier[BR]	*Circus cyaneus*
	Cooper's Hawk[BR]	*Accipiter cooperii*
	Black-Crowned Night Heron	*Nycticorax nycticorax*

Category	Common Name	Scientific Name
	Yellow-Crowned Night Heron	*Nyctanassa violacea*
	Northern Parula[BR]	*Parula americana*
	Piping Plover[T]	*Charadrius melodus*
	Short-eared Owl[BR]	*Asio flammeus*
	American Oystercatcher	*Haematopus palliatus*
	Black Rail	*Laterallus jamaicensis*
	Upland Sandpiper	*Bartramia longicauda*
	Loggerhead Shrike	*Lanius ludovicianus*
	Black Skimmer	*Rynchops niger*
	Henslow's Sparrow	*Ammodramus henslowii*
	Common Tern[BR]	*Sterna hirundo*
	Forster's Tern[BR]	*Sterna forsteri*
	Least Tern	*Sterna antillarum*
	Cerulean Warbler	*Dendroica cerulea*
	Hooded Warbler[BR]	*Wilsonia citrina*
	Swainson's Warbler	*Limnothlypis swainsonii*
	Red-headed Woodpecker	*Melanerpes erythrocephalus*
	Sedge Wren	*Cistothorus platensis*
Reptiles	Leatherback Sea Turtle[E]	*Dermochelys coriacea*
	Atlantic Ridley Sea Turtle[E]	*Lepidochelys kempii*
	Green Sea Turtle[T]	*Chelonia mydas*
	Loggerhead Sea Turtle[T]	*Caretta caretta*
	Bog Turtle[T]	*Clemmys muhlenbergii*
	Corn Snake	*Elaphe guttata guttata*
Amphibians	Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*
	Barking Treefrog	*Hyla gratiosa*
Mammals	Delmarva Fox Squirrel [E]	*Sciurus niger cinereus*

Category	Common Name	Scientific Name
Fish	Atlantic Sturgeon	*Acipenser oxyrhynchus*
Mollusks	Yellow Lampmussel	*Lampsilis cariosa*
	Eastern Lampmussel	*Lampsilis radiata*
	Dwarf Wedgemussel[E]	*Alasmidonta heterodon*
	Eastern Pondmussel	*Ligumia nasuta*
	Brook Floater	*Alasmidonta varicosa*
	Tidewater Mucket	*Leptodea ochracea*
Insects	Little White Tiger Beetle	*Cicindela lepida*
	White Tiger Beetle	*Cicindela dorsalis*
	Seth Forest Scavenger Beetle	*Hydrochus sp.*
	Frosted Elfin	*Incisalia irus*
	Bethany Firefly	*Photuris bethaniensis*
	Hessel's Hairstreak	*Mitoura hesseli*
	King's Hairstreak	*Satyrium kingi*
	Rare Skipper	*Problema bulenta*
	Mulberry Wing	*Poanes massasoit chermocki*

[BR] Breeding population only

[T] Federally listed Threatened Species

[E] Federally listed Endangered Species

8.4.2 Sea Turtles

8.4.2.1 Sea Turtles in Delaware

Table 8-10 lists multiple species of sea turtles native to Deleware's coast that have been identified by the State of Delaware Division of Fish and Wildlife to be "Species of Greatest Conservation Need" as defined in the Delaware Wildlife Action Plan. All of these turtles, with the exception of the hawksbill sea turtle, are also listed as endangered species in Deleware as shown in Table 8-9. Species of concern are divided into two tiers based on the need of conservation action. Tier 1 indicates "Species that are most in need of conservation action in order to sustain or restore their populations" and Tier 2 indicates "Species in need of conservation action but without the urgency of Tier 1 species". (DNREC 2011)

Table 8-10 Turtle Species of Greatest Conservation Need (DNREC 2011) (USACE 2009)

Tier	Habitat	Common Name	Scientific Name
Tier 1	Nearshore Habitats	Green sea turtle	Chelonia mydas
Tier 1	Nearshore Habitats	Hawksbill sea turtle	Eretmochelys imbricata
Tier 1	Nearshore Habitats	Kemp's Ridley sea turtle	Lepidochelys kempii
Tier 1	Nearshore Habitats	Loggerhead sea turtle	Caretta caretta
Tier 1	Deepwater Pelagic Habitats	Leatherback sea turtle	Dermochelys coriacea

From 2000 to 2011, 388 sea turtle strandings were recorded in the state of Delaware (Thurman 2012). A breakdown by species and year is presented in Table 8-10A.

Table 8-10A Sea Turtle Strandings in the state of Delaware (Thurman 2012)

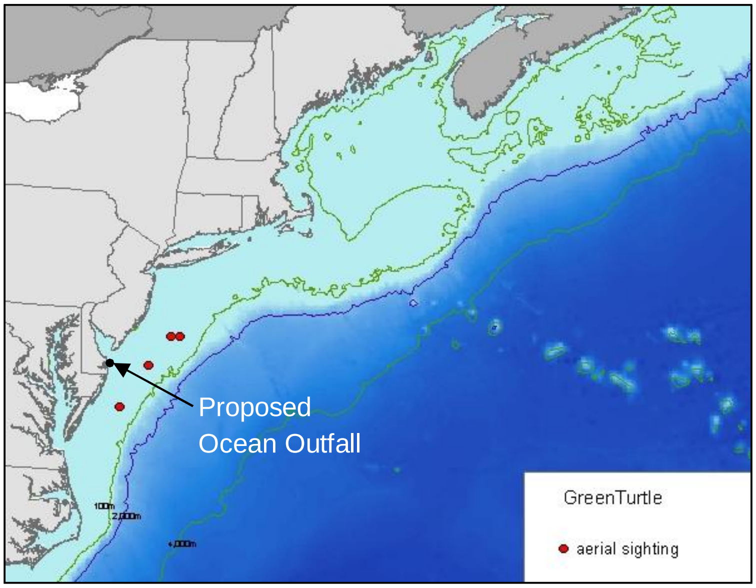
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Loggerhead	25	14	41	39	23	18	29	24	17	29	13	17	289
Green	0	0	1	0	0	0	0	0	0	2	0	1	4
Leatherback	1	3	1	0	13	5	4	2	1	2	0	0	32
Kemp's Ridley	3	2	3	0	4	1	3	1	0	2	1	6	26
Hybrid	0	0	0	0	1	0	0	0	0	0	0	0	1
Unidentified Sea Turtle	1	2	12	1	7	3	2	3	0	0	4	1	36
Total	30	21	58	40	48	27	38	30	18	35	18	25	388

8.4.2.1.1 Green Sea Turtle

The green turtle (*Chelonia mydas*) is found around the globe between the northern and southern 68° F (20° C) isotherms. Green turtle nesting occurs from June to September on the Atlantic coast of Florida (USACE 2009). Observed green turtle sightings during summer NOAA aerial and shipboard surveys in 1998, 1999, 2002, 2004, and 2006 are presented in Figure 8-32. Winter months are not included in the NOAA survey map. From 2000 to 2011, 388 sea turtle strandings were reported in Delaware, of which four (4) were identified as green sea turtles (Thurman 2012).

Green turtles are primarily herbivores, consuming mainly sea grass and algae. Their diet also includes the organisms that live on the sea grass and algae (USACE 2009).

Figure 8-32 Aerial Sightings of Green Turtles (NOAA 2011)



8.4.2.1.2 Hawksbill Sea Turtle

The hawksbill sea turtle (*Eretmochelys imbricate*) typically inhabits coral reefs and rocky places, such as those found in Central America and the Caribbean, and they are relatively uncommon in the waters of the continental United States. Adult hawksbill turtles do not typically travel beyond the tropics, though small hawkbill strandings have occasionally occurred as far north as Cape Cod. Hawksbill nesting in the western Atlantic extend from Brazil to Florida (USACE 2009). From 2000 to 2011, 388 sea turtle strandings were reported in Delaware, of which none were identified as hawksbill sea turtles (Thurman 2012).

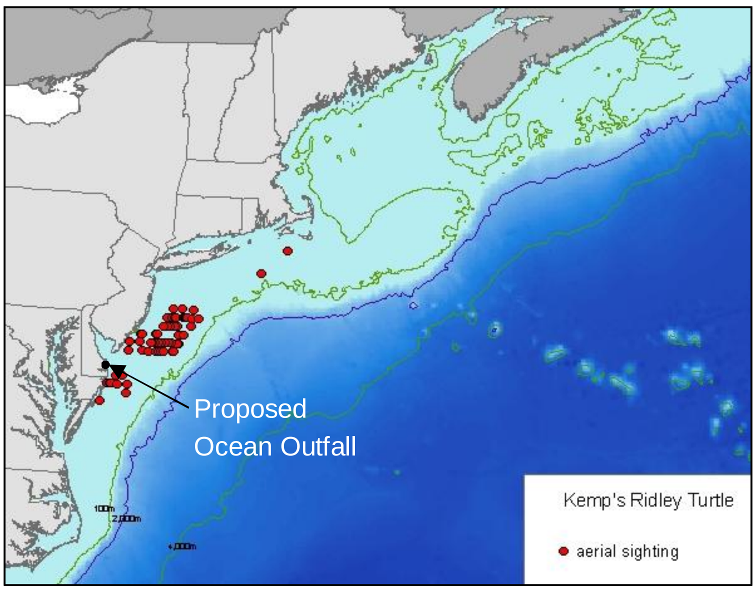
Hawksbill turtles feed primarily on sponges, though they also consume mollusks, bryozoans, and coelenterates (USACE 2009).

8.4.2.1.3 Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle (*Lepidochelys kempii*) is typically found in sheltered coastal areas, large estuaries, bays and lagoons in the temperate, subtropical and tropical waters of the Atlantic Ocean and the Gulf of Mexico. Seasonally, Kemp's ridley sea turtles are common as far north as the Gulf of Maine, but during winter months they shift to the south. Nesting of Kemp's ridley sea turtles occurs primarily from April to July almost exclusively near Rancho Nuevo, Tamaulipas, Mexico, with reports of nesting near Padre Island, Texas and Veracruz, Mexico (USACE 2009). Observed Kemp's ridley sea turtle sightings during summer NOAA aerial and shipboard surveys in 1998, 1999, 2002, 2004, and 2006 are presented in Figure 8-33. Winter months are not included in the NOAA survey map. From 2000 to 2011, 388 sea turtle strandings were reported in Delaware, of which 26 were identified as Kemp's ridley sea turtles (Thurman 2012).

Kemp's ridley sea turtles are omnivorous and feed on fish, jellyfish, mollusks, crustaceans, and swimming crabs (USACE 2009).

Figure 8-33 Aerial Sightings of Kemp's Ridley Sea Turtles (NOAA 2011)

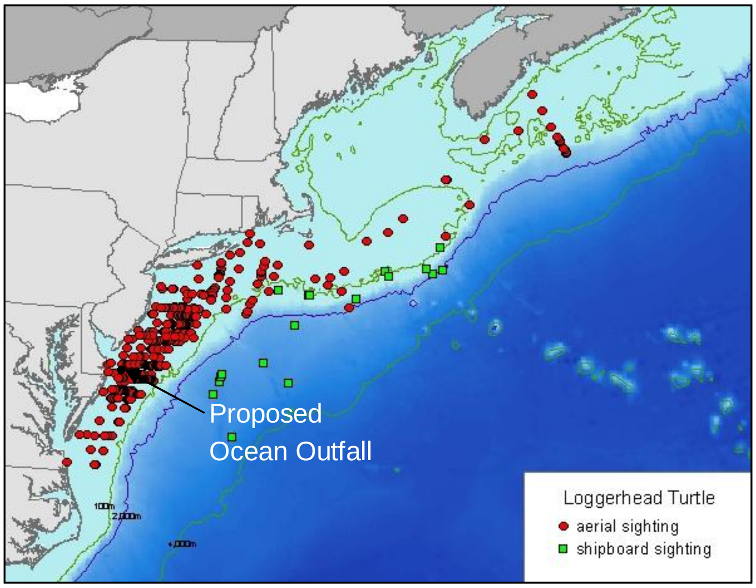


8.4.2.1.4 Loggerhead Sea Turtle

The loggerhead sea turtle (*Caretta caretta*) typically inhabits continental shelves, bays, lagoons, and estuaries in the subtropical, tropical, and temperate waters of the Pacific, Indian, and Atlantic Oceans. In the western Atlantic, loggerhead sea turtles occur from Argentina to Nova Scotia, though during the winter, they typically shift south. Loggerheads are frequently found around coral reefs, rocky places, and boat wrecks, and are most common in waters less than 164 ft (50 m) in depth (USACE 2009). Observed loggerhead sea turtle sightings during summer NOAA aerial and shipboard surveys in 1998, 1999, 2002, 2004, and 2006 are presented in Figure 8-34. Winter months are not included in the NOAA survey map. From 2000 to 2011, 388 sea turtle strandings were reported in Delaware, of which 289 were identified as loggerhead sea turtles (Thurman 2012).

Loggerhead sea turtles are primarily carnivorous and consume a variety of benthic organisms including mollusks, crabs, shrimp, jellyfish, squids, sponges, sea urchins, and fishes (USACE 2009).

Figure 8-34 Aerial Sightings of Loggerhead Sea Turtles (NOAA 2011)

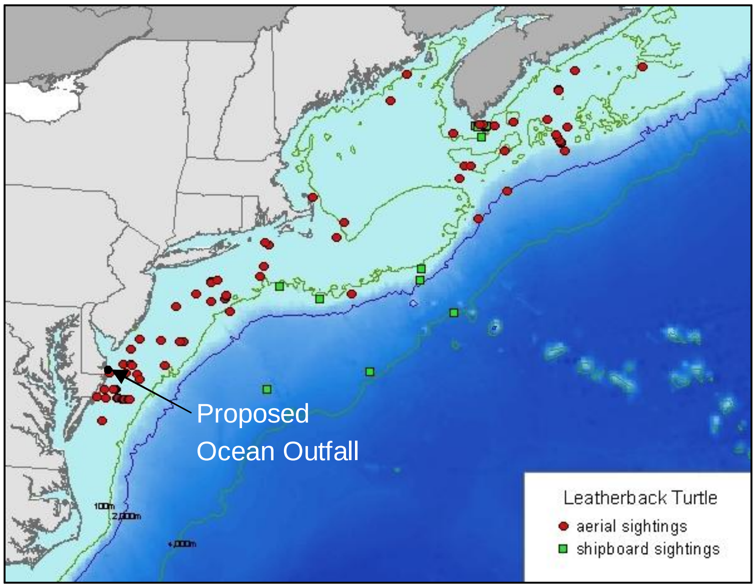


8.4.2.1.5 Leatherback Sea Turtle

The leatherback sea turtle (*Dermochelys coriacea*) is found around the globe within the Atlantic, Pacific, and Indian Oceans, and their population extends from Labrador, Canada to South America. Leatherback sea turtle nesting occurs from March to September along the mid-Atlantic coast of Florida (USACE 2009). Observed leatherback sea turtle sightings during summer NOAA aerial and shipboard surveys in 1998, 1999, 2002, 2004, and 2006 are presented in Figure 8-35. Winter months are not included in the NOAA survey map. From 2000 to 2011, 388 sea turtle strandings were reported in Delaware, of which 32 were identified as leatherback sea turtles (Thurman 2012).

Leatherback sea turtle diets consist primarily of soft-bodied animals such as tunicates and jellyfish, as well as amphipods, juvenile fishes, and other organisms (USACE 2009).

Figure 8-35 Aerial Sightings of Leatherback Sea Turtles (NOAA 2011)



8.4.2.2 Short Term / Temporary Impacts

8.4.2.2.1 No Action

The no action alternative would involve no new construction, thus there would be no short term impact on sea turtles.

8.4.2.2.2 Land Application

There will be no short term impacts to sea turtles from the land application alternative, as no construction will occur in any aquatic environments.

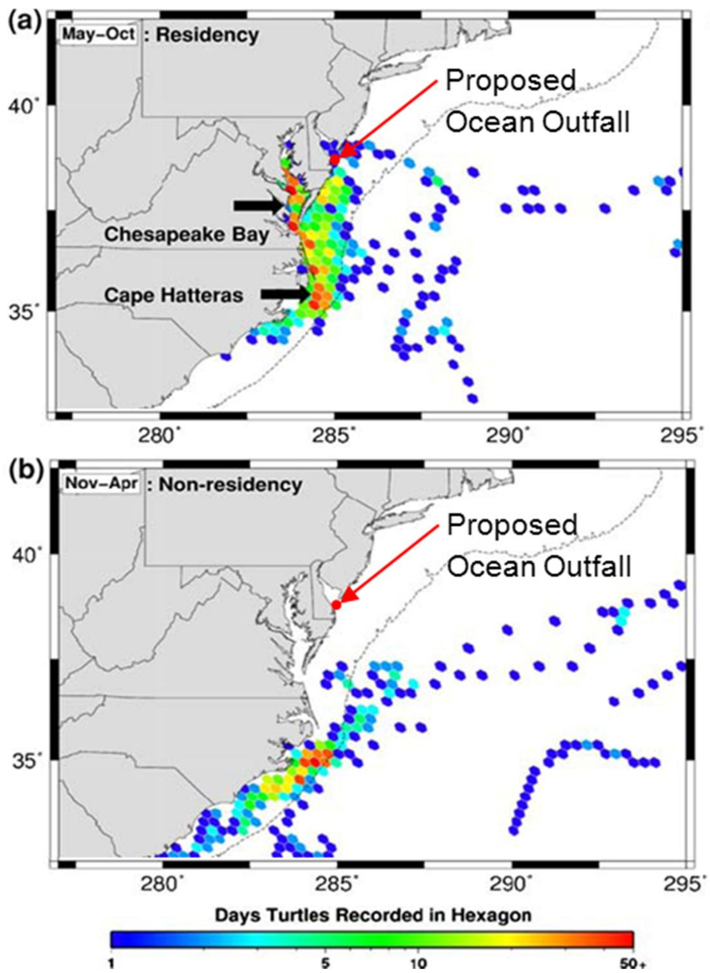
8.4.2.2.3 Ocean Outfall

The only construction activity under the ocean outfall alternative that could potentially impact turtle populations would be the dredging of the portion of the outfall pipe not directionally drilled. Trailing Suction Hopper Dredging (TSHD) has been implicated in sea turtle deaths, however, as discussed in Sections 4.5.4 and 4.5.5, clamshell or CSD will likely be utilized. These methods carry a low risk of adversely affecting sea turtles (USACE 2009), In contrast to TSHDs, the method of operation of the CSD ensures there is ample warning to turtles of the approach of the dredger, as:

- The dredger progresses forward at a very slow rate;
- The action of the cutter engaging the seabed causes substantial vibration; and
- Dredging typically undercuts the seabed and the material slumps into the cuts. Movement of the seabed ahead of the slumping will provide warning to turtles.

Even with hopper dredging, no impact to turtle species would be expected if dredging was to occur between the months of December and April. During these months, the sea turtles have migrated to warmer waters south of the Delaware coast line (Shoop and Kenney 1992) (Mansfield, et al. 2009). The difference in the seasonal distribution of juvenile loggerhead turtles, as shown in Figure 8-36, exemplifies the movements of sea turtles throughout the year. Construction of the ocean outfall is most likely to occur during the winter months when plant flow is the lowest, so impact to sea turtles during construction is virtually non-existent.

Figure 8-36 Distribution of Juvenile Loggerhead Turtles from May to October (a) and from November to April (b) (Mansfield, et al. 2009)



8.4.2.3 Long Term / Chronic Impacts

8.4.2.3.1 No Action

The no action alternative will continue to discharge disinfected effluent into Rehoboth Bay, where sea turtles have been documented (E. Stetzar 2011). There is the potential for long term impacts to sea turtles within the Bay if effluent continues contribute to the Bay's poor water quality. The abundance and distribution of sea turtles is currently unknown, so the extent of the impact cannot be determined.

8.4.2.3.2 Land Application

Effluent is not disposed into any aquatic environment in the land application alternative, so the alternative will have no long term or chronic impacts to sea turtles.

8.4.2.3.3 Ocean Outfall

The sea turtles associated with the area of concern are mobile and migratory and thus exposure to any contaminant is expected to be transient and minimal. As stated previously, any contaminant potentially present is rapidly diluted to below minimum water quality standards or to non-detectable levels (see Chapter 6).